MACHINERY.

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SHOP CONSTRUCTION.—1.*

GENERAL PLANS FOR A MODEL PLANT.

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The "eternal fitness of things" requires that in whatever we design, build, equip and arrange for producing our portion of the product of the world's vast commerce, we shall strive to make it the best of its class; also, the best adapted for the special uses to which it will be put, the kind of goods to be manufactured, the circumstances, conditions and surroundings under which we work, etc.

In a great majority of cases the manufacturing plants of this country have been the result of *growth*, more or less rapid. Often they began with meager accommodations, which, as means allowed and necessity required, have been gradually added to. And thus the establishment became an aggregation of buildings of various sizes and forms, ofttimes representing in a general way the worst arrangement for economically producing work. At the same time it represented the total expenditure of a much greater amount of capital than would have been necessary to erect and equip good buildings, well suited to the practical necessities of the business.

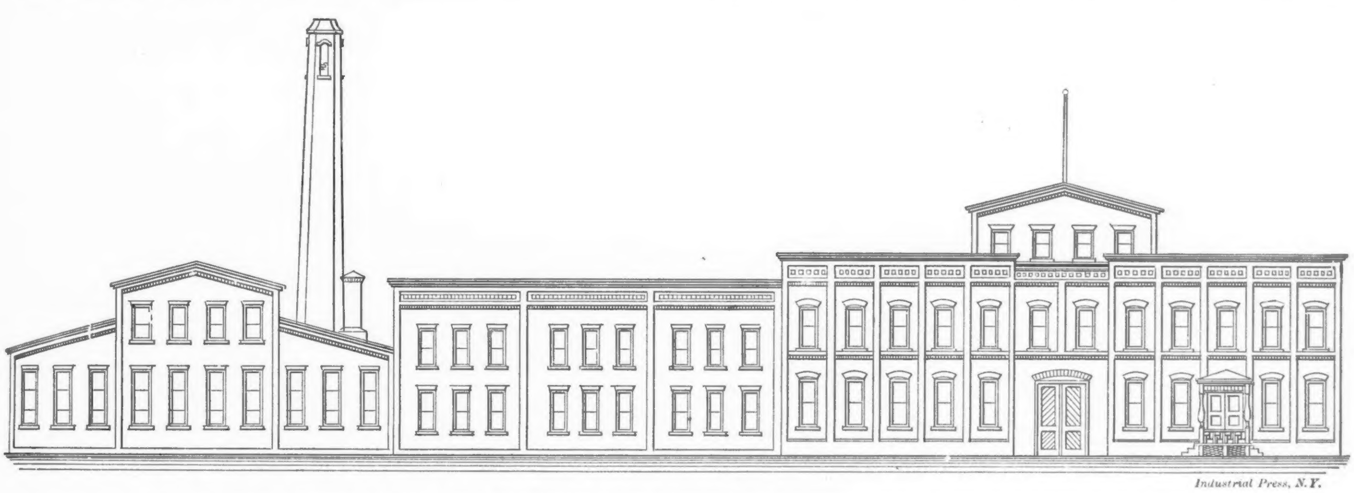

Fig. 1. Front Elevation of Shops for a Model Plant to build Medium Sized Machinery. Scale, one inch equals forty feet.

There are numerous establishments in this progressive country to-day occupying antiquated and rambling structures that have cost money enough for the building of modern works properly designed for the economical production of a much higher grade of goods than it is possible to manufacture in old plants.

The world moves, and nowhere is this more apparent than in manufacturing. That which would answer the purposes of a business even five or ten years ago is among the "back numbers" to-day. The constant striving for the best was never more in evidence than at the present time among our up-to-date, progressive manufacturers, who are able to look beyond first cost to the greater advantages to be gained later on. The aim of this series is to discuss, from a practical standpoint, what is the best design, arrangement, equipment and management of manufacturing plants erected for the production of a medium-sized class of machinery, from the reception of the raw material to the shipping of the finished product. With this in view cuts showing the general plans for suitable buildings of a size and capacity for the usual work, arranged in compact form, of modern construction and supplied with conveniences for handling material and product, accompany this article. The entire plant, shown in Fig. 1, requires a site of somewhat less than 300 x 450 feet.

Fig. 2 shows a compact design to meet cases where the amount of land is limited and illustrates how all the buildings may be so grouped as to render the handling of materials and transportation of them as simple, direct and economical as possible. A railroad track should pass near the works, and from it a branch should be brought closely past the rear and to one side of the collection of buildings. Such an arrangement results in a great saving in the expense of hauling both material and product, and permitting the general arrangement and development of the plan herein proposed.

The main building, or machine shop, is 100 x 375 feet, divided lengthwise into a central portion 40 feet wide and 52 feet high, with side wings or bays each 30 feet wide. The central portion is open clear to the roof and has a traveling crane of ample capacity moving over its entire length. The side wings are divided into a main floor, on a level with the central portion and a gallery, or second floor; the first being 16 feet and the latter 14 feet high in the clear. This gallery is also built across 18 feet of the front end, thus connecting the two galleries and furnishing a platform by way of which the traveling crane may transfer material and product to and from the main floor. Along the center of these galleries and across the front end runs a tram track, provided with light push cars for facilitating the transfers. Stairways are provided at each end and in the center for conveniently and speedily reaching any part of the shop from floor to galleries and *vice versa*.

At the front end of the machine shop proper are the offices connected with and forming a part of it, consisting of two structures 50 feet square, with a driveway space of 20 feet between them. On the first floor of one of these are the offices, storeroom, etc., and in the other the tool-making room, a room for storage tools and fixtures and a stock room for small finished parts. On the second floor is located the drawing room, while over the driveway is the pattern shop. The offices are only those particularly connected with the manufacturing and shipping, and not the general offices of the company. A wing connects the front buildings with the foundry. The ground floor of this wing is used as a storage room for pig and scrap

* This is the first of a series of articles upon the design and construction of machine shops, treating of the various parts of a plant, from foundation to roof, and including hints upon the arrangement of tools and the management of the completed plant. The intention will be to give such information about the special requirements of machine shops as an architect, or structural engineer who has had no shop experience, usually does not possess.

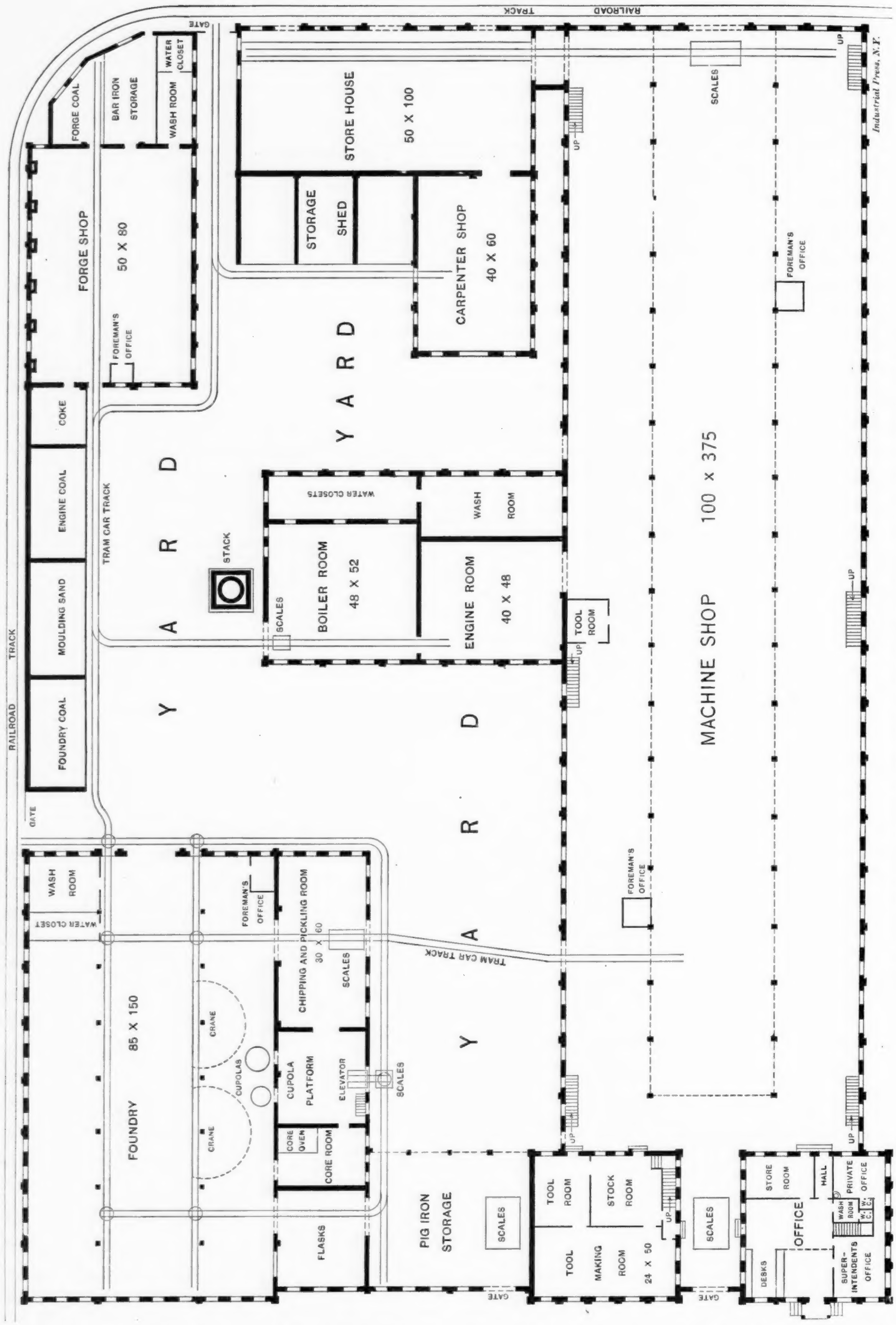

Fig. 2. Plan of Works shown in Elevation on the first page. Scale, one inch equals forty-eight feet.

iron, and a flask room, while the second floor is a pattern storage loft, connected at one end with the pattern shop and at the opposite end with the foundry by a trap door 8 x 18 feet, directly over the train track leading through the flask room.

The foundry is 85 x 150 feet, arranged with a central part 35 feet wide and two side wings or bays, each 25 feet wide. The central part is covered by a traveling crane running the entire length. There are two cupolas, a large and a small one, served by two cranes of sufficient reach to swing into the central space covered by the traveling crane. Large work is cast in the central space or within reach of the cranes, while small work and bench molding occupy parts of the floor not covered by the cranes. On each side of the central part are tram tracks, which are crossed by one running to the flask room and one that goes through the chipping room and on across the yard to the machine shop.

A wing built on the side of the foundry toward the machine shop contains a platform upon which coal and iron for charging the cupolas are delivered by a tram car raised to that level by an elevator arranged for the purpose. This stock is weighed on track scales in front of the elevator. Beneath the cupola platform are the tumbling barrels, convenient to the cupolas for working over the slag, and to the chipping room for cleaning small castings. The flask room is located at the

front, while between it and the tumbling barrel space is the core room, containing a suitable core oven. At the opposite end, facing the yard, is the chipping and pickling room, where the castings brought in from the foundry are pickled, chipped and weighed, before being sent to the machine shop. If the castings are too heavy for convenient handling in the chipping room they may be run through to the yard and there handled by a boom crane covering the tram track upon which they are run into the machine shop. Castings of moderate size, yet too heavy to move by hand, are expeditiously handled by a light overhead trolley hoist in the chipping room. At one end of the outer wings are the wash room and toilet. If more floor space is needed these may be located in a gallery placed 8 or 10 feet above the foundry floor. In the further corner of the yard, as far as possible from the foundry and engine room, is the forge shop, 50 x 80 feet, which is reached by tram cars, the track running through its length near the center. On the outer walls are the chimneys for the forges and heaters, and in the rear are the storage shed for bar iron and steel, the wash room, toilet, and space for coal. These adjuncts are in a shed built with brick walls and of such outline as to conform somewhat to the curve of the railway track, the forge shop having been so located as to admit of this arrangement.

When down-draft forges, served by exhaust fans, are used, it will not be necessary to build more than one chimney, the flue of which should be large enough to carry off the smoke and gases from all the forges.

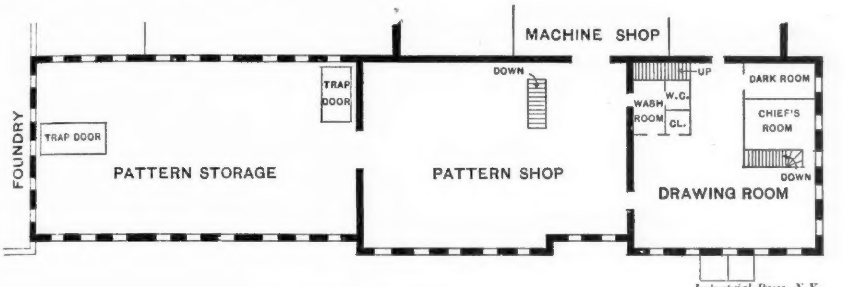

Fig. 3. Plan of Second Floor in Foundry. Scale, one inch equals forty-eight feet.

The power house is located midway in the length of the machine shop, so that power may be applied to the line shafting at a point that prevents much of the torsion incident to long lines of shafting driven from one end. This building is 65 x 100 feet and contains the engine room, 40 x 48 feet; the boiler room, 48 x 52 feet, and also the wash room and water closets used by workmen in the machine shop. Near the boiler room is the chimney stack, with which the smoke flues of all the boilers are connected. Coal is brought in on push cars along the tram track, to the front of the boilers, where a track scale is placed for weighing it. Ashes are removed by the same tram track to whatever point is most desirable to deliver them. Across the rear end of the yard is the storehouse, 50 x 100 feet, for finished machines, or product. This connects with the rear end of the machine shop by a tram track running from the scales beneath the traveling crane through a wide doorway and the whole length of the storehouse. The rear side of the storehouse (next to the railway track) has wide, sliding doors, through which the finished product is readily moved into the railway cars for shipment. Here, as in the chipping room of the foundry, it may be desirable to make use of overhead trolley hoists to facilitate rapid and economical handling of machinery to be shipped. A 12-foot space is left between storehouse and forge shop for a branch of the tram tracks, as a convenient means of receiving material from the railway at this point.

Adjoining the storehouse is the carpenter shop, 40 x 60 feet. Thus the men who prepare the finished machinery for shipping are near their work, and the lumber used for this purpose, and the necessary machinery for cutting it up, are close at hand and require no unnecessary handling. In the angle formed by the storehouse and carpenter shop are the storage sheds for cast iron and steel chips from the machine shop, or for similar materials.

Along the side of the yard, and extending from the forge shop to within 20 feet of the foundry are arranged the stock sheds. These hold foundry sand and coal, engine coal, coke, etc., which is delivered into them directly from the railway cars, the track being raised to the proper grade after it has passed the storehouse. It is continued the whole length of the foundry so as to deliver foundry sand directly into the windows of the foundry if desirable, keeping that in the storage shed as a reserve supply. Between the storage sheds and foundry is a gate, through which may pass a branch of the tram car track for receiving stock and material from the railway cars at this point. Details of the plans herein outlined and the progress of the work from the raw materials to the finished product will be given in future articles. The second article will deal especially with the construction of the buildings.

Whatever may be the dimensions of the building of a manufacturing plant, or however carefully provision be made for all necessities for handling materials, etc., there is always the possibility, and frequently the probability, that some day the works will have to be increased in capacity or changed in form. It is, therefore, important to consider these points at the outset, and to provide for an expansion of the business in accordance with future needs and at the same time not to disarrange or break up the general plan of the works. With these points in mind, I give the two following plans for enlarging the machine shop when more room is needed: First, the building may be extended to the rear across the railway track, the rear wall being removed and the traveling crane tracks continued through the length of the additional building. Doors are provided for the passage of cars upon the railway track, and also a specially-built car habitually used for connecting the floors of the old and new building, its platform being on a level with the two floors. Thus the machine shop capacity could be increased to any reasonable extent. Second, one, two or three wings may be built at right angles to the machine shop and on the side opposite the power house. These might be of one or two stories and of any desired length. They may contain traveling cranes to convey material to and from the traveling crane of the main shop, or have convenient trolley hoists and train car tracks, according to the character of the work to be done.

The capacity of the foundry may be increased one-third by extending it toward the power house. The same space may be obtained by using for foundry space that provided for chipping, core and flask rooms and providing space for the latter by extending the building toward the machine shop. The space occupied by the wash room and water closet will, of course, be taken also and these rooms placed in a gallery, as heretofore suggested. To obtain additional power space for these enlargements the space occupied by the wash rooms and water closets may be utilized and these rooms provided for in an addition built toward the carpenter shop.

By some one of these plans, or a combination of them, the capacity of the works may be at least doubled without seriously disturbing the general plan here described and illustrated and without impairing the general efficiency of the facilities for handling the work.

This design is in as compact a form as is advisable, with a view to sufficient yard space. Where the amount of land is ample it would be manifestly desirable to spread out the design more by increasing the distance between the machine shop and foundry at the front, and the storehouse and forge shop at the rear; or by lengthening the machine shop 50 to 100 feet and thus add to the yard room.

Either or both these plans might be employed where the extent of ground would admit of it, as it is seldom we have too much yard room.

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A so-called fluid lens has been invented by a Dr. Grun, of London, which has extreme rapidity. It is stated that it will produce excellent instantaneous photographs with artificial light such as might be had for example in a theater or other well lighted interiors.

THE LODGE & SHIPLEY DRAWING ROOM.

A WELL ARRANGED OFFICE HAVING NUMEROUS FEATURES OF INTEREST.

C. F. P.

The drawing room of the Lodge & Shipley Machine Tool Co., while small in comparison with those of many other large machine builders, has had much thought devoted to its equipment. This has been done with a view to securing facilities and conveniences that might assist the draftsman in full concentration of thought and energy upon the work in hand. Many improvements in drawing room equipment have recently been added and, as much interest has been manifested therein by visitors to the works, by special request I will endeavor to describe and illustrate some of them for the benefit of readers of MACHINERY.

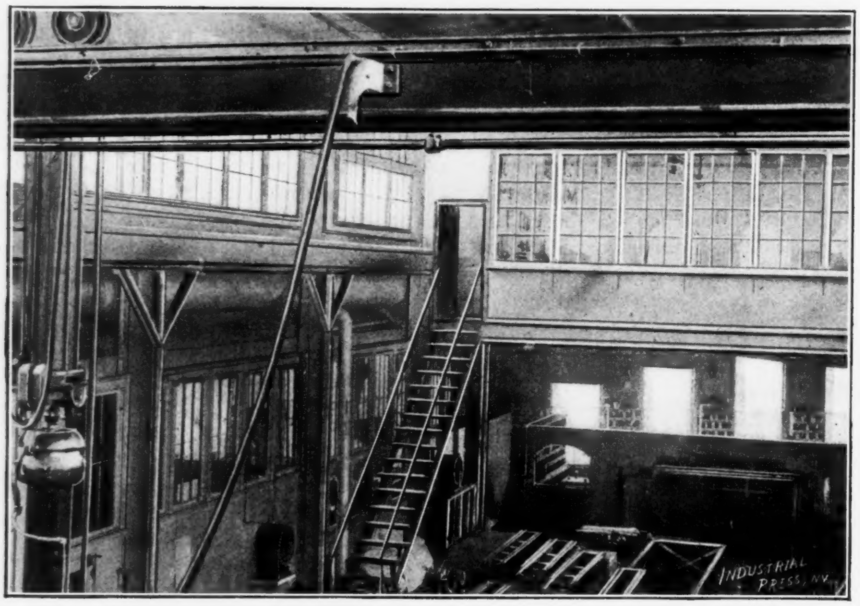


Fig. 1. View showing Location of Drawing Room at End of Shop.

Suitable quarters for the drawing room were not provided in the original plan of the building, and no room being available which would be convenient to the office and shop, it was decided to locate the necessary space 14 feet above the shop floor, at the office end of the building. This gives us a 15-foot ceiling in the drawing-room and a floor space of about 900 square feet, with light on all sides. Fig. 1 is an illustration showing the stairway to the drawing-room entrance and gives a fair idea of the location. Fig. 3 is an interior view of the northwest corner of the drawing-room, the vestibule landing of the stairway and entrance showing in the extreme left. In the center background of the illustration is shown the revolving blue-print rack, upon which is mounted a print of every standard, up-to-date drawing of regular construction, indexed and arranged for the drawing-room force and shop foremen, for convenient reference. This rack, which is more clearly shown in Fig. 8, consists of 80 wings, each wing holding four 12 x 18-inch prints. The prints in the rack are so arranged as to bring together drawings of similar parts of all sizes. The details in the illustration are too small to be clearly seen, but it may be said in explanation that the rack stands open at "Reverse Plate" and shows the 18, 20, 22, and 24-inch prints; the 14 and 16-inch are on the reverse side of the left wing; the 27 and 30-inch on the reverse of the right wing, with the larger sizes following in the next wing in regular order. This system of mounting prints for reference is also used throughout the works.

In front of the rack is the card index cabinet, the upper unit of which is devoted to the indexing of all the drawings in the safe and file; all prints in the file and in the shop; all changes in regular construction; all material carried in stock, etc., etc., and is in a position easily accessible to the safe-and-file attendant and also to the drawing-room help. The lower unit faces the opposite way, and is, together with the base cabinet, devoted to the filing and card indexing of catalogues and printed matter intended for reference.

The safe shown in Fig. 3 contains 36 shallow drawers of galvanized iron, which are numbered and alphabetically labelled, an arrangement which allows the almost instantaneous locating of any drawing in the safe without reference to the card index. The fire-proof safe is used only for live drawings, and it is a rule of the room that all tracings be placed therein at night, thus insuring their safety in the event of fire.

The cabinet to the right of the safe consists of 150 shallow galvanized iron drawers, arranged the same as those in the safe, each drawing being numbered and labelled to indicate the contents. Fig. 7 shows the construction of these drawers more clearly and also the arrangement of labelling. The back of the drawer has an overlapping edge three inches wide which holds the sheets in position and prevents the back edges catching on the drawer above. No space is wasted, the drawer sliding in the grooved sides of the cabinet. The cabinet has a sliding door covering the entire front which when closed makes it dust-proof.

Fig. 4 shows the cabinet with door closed, and also gives an excellent idea of the arrangement of the tables to utilize the floor space to the best advantage. The tables in front of the windows, of which there are three, are for the use of the tracers, and each is fitted with a glass top for tracing, by transmitted light, either sun or artificial. This permits a tracing to be made even on heavy bristol board. Each draftsman is equipped with a drawing table, the construction of which is clearly shown in the several views of the room, and probably requires no further description.

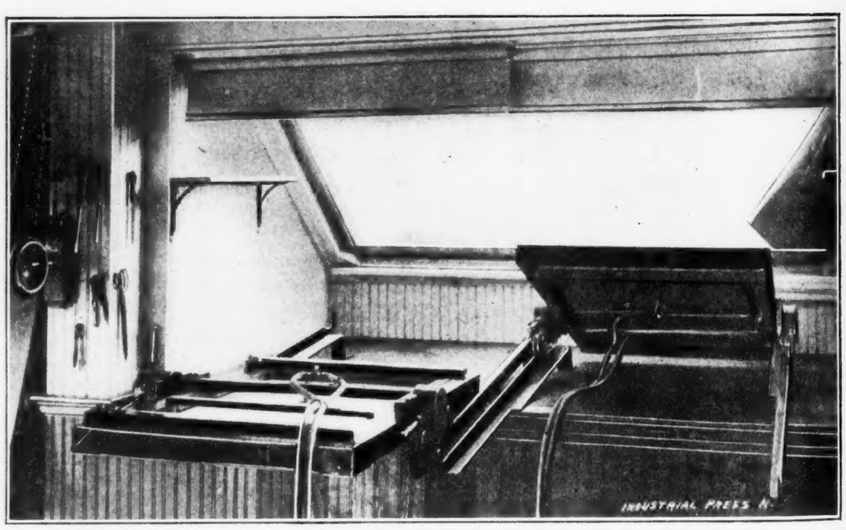


Fig. 2. Blueprint Frames and Window for Printing.

In Fig. 9 is shown in detail as well as complete the lamp we have made for use on the drawing tables. The vertical tube slips freely over the screw of C clamp; on this tube slides the cross carrying the horizontal telescoping tubes. At the outer end of the telescoping tubes is the elbow, in which swivels the T supporting the branches that carry the lamp and shade. The shade is of aluminum with wood and sheet brass ends. This arrangement allows placing the lamp in a way to get the full benefit of the light on any portion

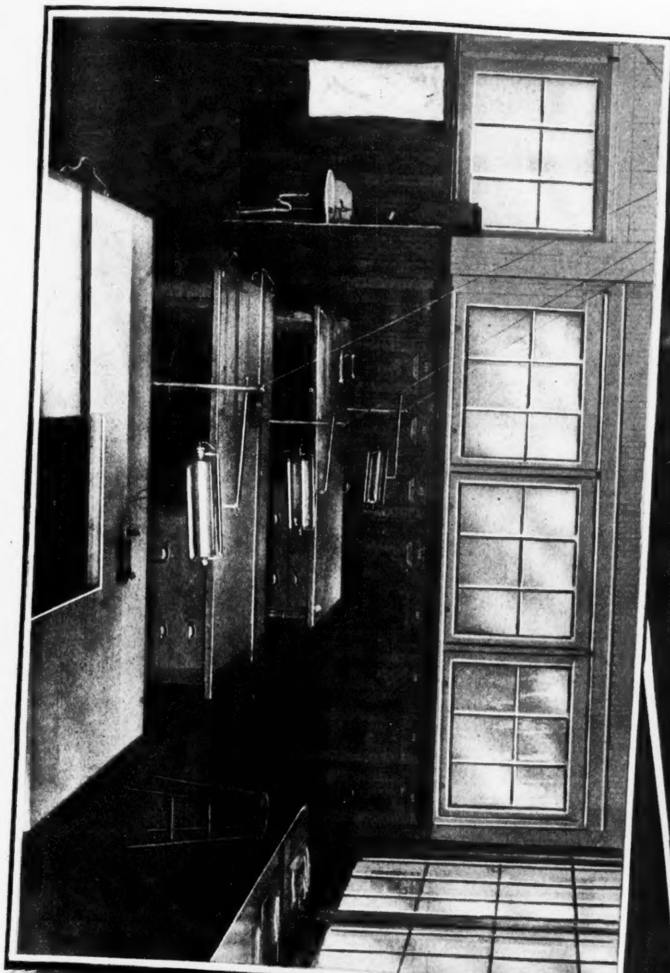
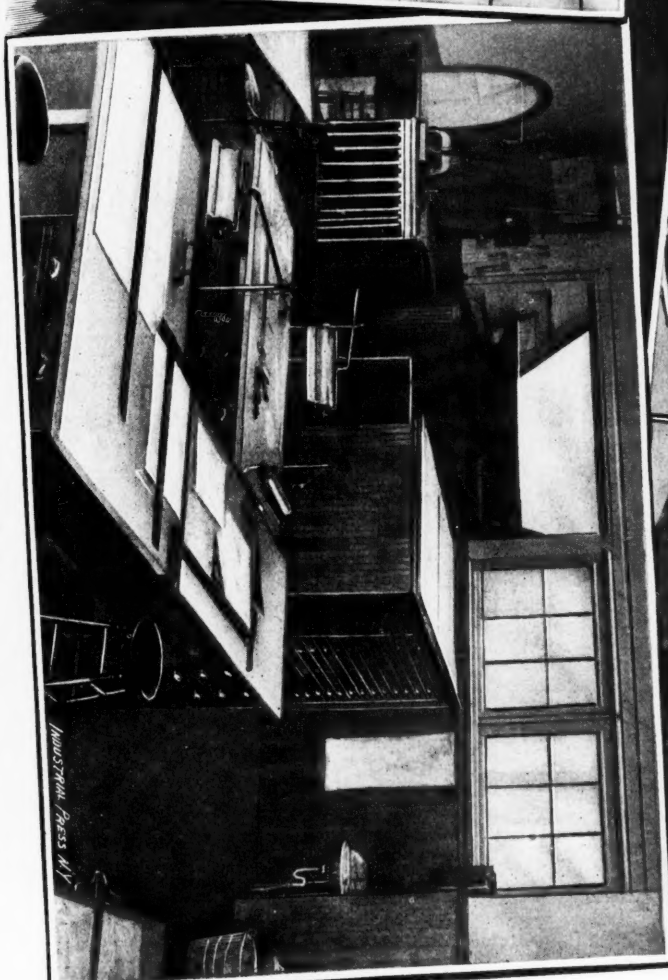


Fig. 3. Northwest corner of Drawing Room.
Fig. 5. Southwest corner of Drawing Room.



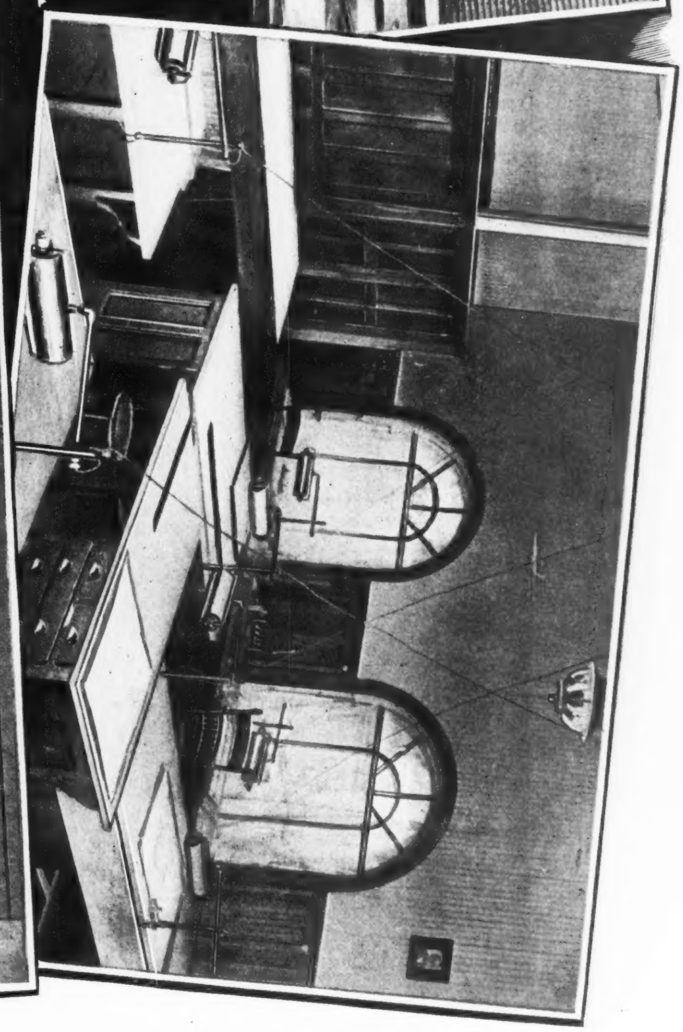


Fig. 4. Northeast corner of Drawing Room.
Fig. 6. Southeast corner of Drawing Room, showing Blueprint Department.

of a drawing on the table, and completely shade the eyes of the draftsman.

The southwest corner of the drawing room is shown in Fig. 5. Arranged along the wall under the windows is a series of lockers for the use of the employees, while to the left is ample provision for washing. At the extreme right is the reference table, provided for general reference purposes. It usually holds a supply of books, magazines, reference drawings, data sheets, etc. When this photograph was made it was being used to accommodate extra tracers.

Fig. 7. Galvanized Iron Drawers of Print Filing Cabinet.

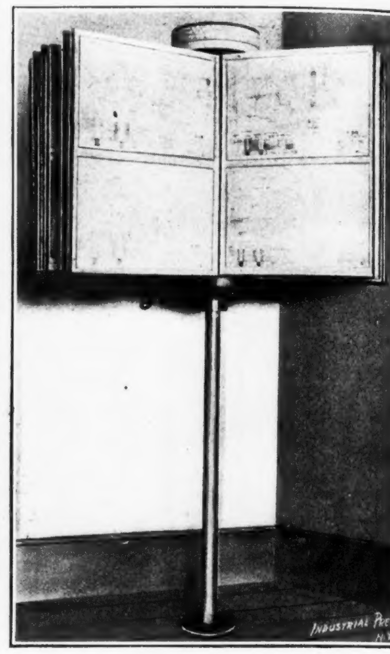


Fig. 8. Blueprint Reference Rack.

The blueprint department is located at the southeast corner, Fig. 6. In Fig. 2 is a larger view of the arrangement, which has several unique features. The blueprint frames are arranged on tracks under a plate glass roof, which allows printing in all conditions of weather when there is light enough for the purpose. The tracings and paper are held to the glass in the frame by atmospheric pressure by the use of a compressed air ejector to remove the air from between the glass and rubber blanket. This is a very convenient arrangement, and gives the most perfect prints from any

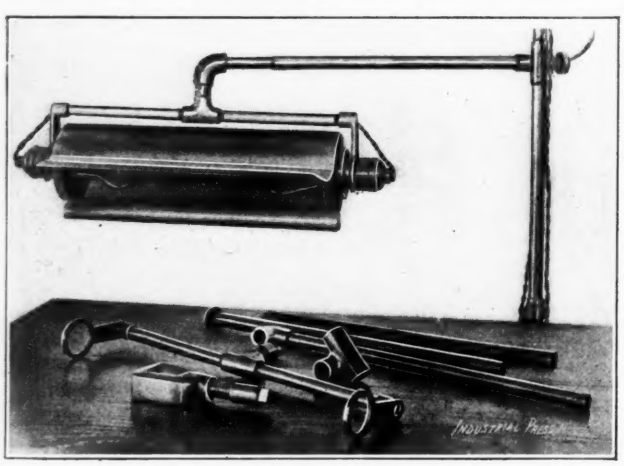


Fig. 9. Drawing Table Lamp.

kind of tracing, as the contact with the sensitive paper is bound to be absolute. One of the frames in Fig. 2 is shown in position for printing and the other for changing tracings. Shades are provided for cutting the strong light from the frame while changing the tracings. The frame carrying the rubber blanket, and to which is fastened the air hose, is hinged at the right of the glass frame and is fastened by buttons at the left. It requires but a few seconds after the blanket frame is closed for the air ejector to extract sufficient air from between the rubber and glass to allow reversing the frame. The shelves at each end of the plate-glass roof are used for small frames in cases where a single small print is required in a hurry, and for prints from negatives.

The blueprint washer and dryer is located in the corner next to the printing frames, and is designed to take as little space as possible. An endless chain carries the prints to the ceiling and back again in the drying process. The floor of this printing department is raised about two feet above the drawing room floor on account of the height of the windows on this side of the room. This height, far from being the handicap we anticipated, has proved to be rather in the nature of an advantage, keeping this department within its own limits, although decidedly limited in space.

The large cabinet of drawers in the center of the illustration, Fig. 6, is used for filing large sheets of original draw-

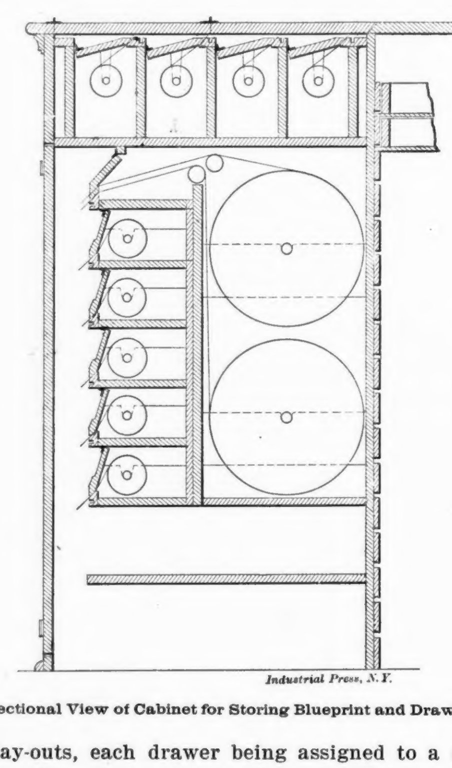


Fig. 10. Sectional View of Cabinet for Storing Blueprint and Drawing Papers.

ings or lay-outs, each drawer being assigned to a single size of lathe or class of drawings, and is of sufficient size to take in a sheet the full size of the drawing without folding. The top of this cabinet is partially covered with plate glass, which forms a table to be used for cutting paper, etc. The front

end of the cabinet is arranged in compartments for storage of rolls of blueprint and drawing papers, and a sectional view is shown in Fig. 10. The four compartments at the top, access to which is secured by raising a section of the top of the cabinet, is reserved for the print papers, four kinds of which are always on hand, and any amount of either can be drawn out without exposing the roll to the light. The compartments on the sides are used for tracing cloth and drawing papers, while the large central compartment is for detail paper and wrapping paper which we use largely for covers to protect the drawings sent into the shop. The cover of each of these compartments is held in place by spring hinges which hold it against a hardwood strip provided with a groove for guiding the knife in cutting the paper.

At the left of the view, Fig. 6, is a cabinet for the storage of extra small drawing boards. On the top of this cabinet is a shear for trimming prints and cutting paper into our standard sizes for use on the tables; also a letter press, used principally for the binding process through which all our data sheets are put. This cabinet has recently been replaced by a table similar in size and construction to the tables used by the draftsmen. Ventilation and cooling in summer is effected by several electric fans and also by a motor-driven exhaust fan mounted in the ceiling.

Visitors are cordially welcome at the Lodge & Shipley plant, and the writer will always be glad to show a MACHINERY reader through the company's drawing-room.

* * *

STEEL AND ITS TREATMENT.—2.

METHODS OF HEATING STEEL.

E. R. MARKHAM.

As stated in a previous article, it is very necessary in order to get satisfactory results that steel be heated uniformly for hardening. In order to get uniform heats when hardening work in large quantities, various methods of heating are used, the method generally depending on the facilities furnished in the shop where the work is done. For instance, if in a shop ten thousand pieces of work are to be hardened, the equipment of the shop is oftener taken into consideration than the very best method of doing that particular piece if it entails an outlay of money to instal the better method. This way of doing is necessary, unless the amount of money saved by the addition of the extra equipment would pay for itself or produce an article enough better in quality to cover the expense incurred. For example, if a manufacturing concern had fifty thousand bicycle cones to harden, and their only method of heating them was an open fire, of the form of a blacksmith's forge, it would cost (estimated) 50 cents per hundred; provided the work was done by a man sufficiently experienced to get satisfactory results. The total cost for hardening the lot would be $250 for labor. Now if a lead-hardening furnace were used to heat the cones, the cost of hardening could be reduced to 10 cents per hundred or a total cost of $50 for labor, saving $200. And as a lead-hardening furnace large enough for any ordinary work can be purchased for $125, the cost of installing the furnace would be saved, with an additional saving of $75. The cost (50 cents per 100 cones) of heating in an open fire is simply an estimate and is given for the sake of illustration; while the amount of 10 cents per 100, given as cost of heating in the lead-hardening furnace is taken from a book of piecework prices paid for work when I was connected with a concern manufacturing bicycles; the men making very satisfactory wages at the rate mentioned.

Many pieces of work may be heated at one time in a large muffler furnace at a much less cost than if an ordinary open fire were used, and with much more satisfactory results. If the work is done in large quantities the price of the muffler furnace may be saved. This is to show the young hardener that the matter of equipment is generally looked at by the manufacturer from a commercial standpoint. If the manager, superintendent, or those having the purchasing of equipment in charge, can be convinced that a saving in cost of production, without a deterioration in quality of product, can be accomplished by the purchase of additional equipment, they are generally very willing to go to the necessary expense. And even if they feel they cannot purchase the equipment advocated, they look upon it as a very favorable sign when a young man is endeavoring to, in any manner, decrease the cost of production in the shop. And the manager, when he finds it necessary to put someone in a responsible position, will certainly favor the man who shows an untiring interest in the welfare of the concern employing him.

When large quantities of small pieces are to be heated for hardening and an ordinary forge is the only means obtainable, a number of pieces of gas pipe of suitable size and length may answer. One end should be closed by means of a cap screwed on, or a piece of steel or iron may be made to fit the hole in the pipe, and a piece 3/8 inch to 1/2 inch thick may be fastened in one end with screws or pins. The pieces to be hardened are then placed in the tubes, care being taken that no more pieces are put in at one time than can be heated uniformly. If a number of pieces of pipe are used at a time there will be a saving in cost.

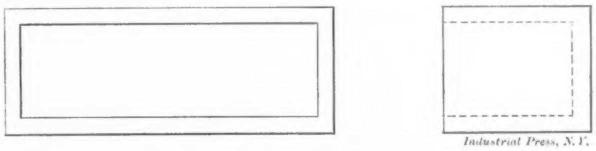


Fig. 1.

It is possible to make an oven of the form shown in Fig. 1 for use in heating articles in the open fire. This may be placed on two pieces of brick or iron in such a manner that the fire may be under, on top, and at the back of it; the coals may also be piled up at the ends. The work which is supposed to be inside the oven and on the bottom heats very uniformly. When the work is first put in this receptacle it may be placed near one end, then as it heats it may be moved toward the center. In this way it does not heat too rapidly, neither do the cold pieces as they are placed in position at the ends chill the pieces in the center, which are red hot and are allowed to remain a few minutes in order to become heated uniformly throughout. A crucible of red-hot lead provides an excellent means of uniformly heating work in large quantities. A ladle, dish or crucible of lead may be heated in an ordinary forge and very satisfactory results obtained in heating the work. This, however, will necessarily be a slow method as compared with furnaces made specially for the purpose. But if obliged to heat the lead in this manner, bricks may be so arranged as to make a place for the crucible and allow the fire to be under it and around it, which furnishes a very uniform heat. It will be found necessary, however, to raise the crucible occasionally and poke the coals underneath it; the lead will also cool somewhat when fresh coal is placed on the fire. The very best results can always be obtained if steel is hardened at the refining heat, that is, the steel should be heated to that degree that when plunged in the bath and hardened the fracture (if the piece be broken) will show a very fine compact grain. Consequently it is necessary to keep the lead at the proper temperature, as nearly as possible, to produce the desired result. If it becomes too cool do not attempt to use it; wait until it is at the proper temperature. If it should get too hot do not continue using it, thinking it will soon cool off. Every piece heated when the lead is in this condition will not give the results it should. If the lead becomes too hot plunge a large bar of cold iron or scrap steel into it, allowing it to remain until it absorbs the extra heat and reduces the temperature of the lead to the proper degree. Then, and not till then, it is safe to go ahead with the work.

One reason why so many fail to get satisfactory results in the use of red-hot lead as a heating medium for hardening steel is because they use a quality of lead unfitted for the purpose. Steel, when in a red-hot condition, is very susceptible to impurities, and the ordinary grades of pig lead are apt to contain impurities very harmful to steel. For this reason scrap lead of an unknown quality should never be used; neither should any brand of pig lead containing sulphur be allowed to come in contact with red-hot steel. I always make it a point to use nothing but chemically pure lead in a crucible to be used for heating steel.

To prevent the surface of the lead from oxidizing from the action of the air upon it the top of the lead should be covered with charcoal, broken in pieces the size of a walnut. This also has a tendency to keep the surface from chilling as the charcoal catches fire and burns. The surface of the lead will oxidize somewhat, however, forming what is familiarly known as dross. This should be skimmed off occasionally or it will stick to the work in spite of all precautions taken to prevent it. As the surface of the lead is exposed to the air and is cooled somewhat by it, and as the tendency of the fire is to heat the lower part of the crucible hotter than the top, it is necessary to occasionally stir the lead in order to obtain uniform heats. This is especially true if long pieces projecting down into the lead are to be heated.

may be placed in the lead. If a number of pieces are placed in the lead at one time and an equal number approximately are dipped in the solution and put in position to dry, then the work may be done in rotation, that is, while the pieces in the lead are heating, those on the furnace will be drying. As soon as the pieces in the lead are sufficiently heated they are taken out, one at a time, with hook or tongs and plunged beneath the surface of the lead to insure even heating. Then the piece is removed and dipped in the hardening bath. While the pieces are heating it is advisable to turn them occasionally in the lead to insure uniform results.

A piece of steel heated in red-hot lead in such a manner that a portion of it was not submerged in the lead, as shown in Fig. 2, should be moved up and down in the lead a trifle to avoid what is known as a fire crack. That is, the steel below and at the surface of the lead would be subjected to an intense heat, while the steel above the surface would be at nearly its normal temperature; and as the effect of the heat is to expand the steel, the point where it ceased expanding would be at or about at the top of the lead, and if held stationary in the lead the effect on the steel is liable to be disastrous. To avoid any such result the piece should be raised and lowered somewhat in the lead, distributing the strain over a larger surface and thus doing away with the tendency to crack. If pieces of irregular contour, differing greatly in size at different portions as shown in Fig. 5, are to be heated in lead, it is advisable to heat them nearly to a red in an open fire or in some manner to avoid the unequal strain to which the piece would be subjected were it to be plunged when cold into red-hot lead. It would be impossible for the large and small portions to expand equally, and the consequence would be a crack or innumerable cracks; and, unless the operator were aware of the effects of violent, uneven heats on high carbon steels, these cracks would be laid to the bath, that is, he would think the steel cracked in the cooling bath, when in reality the cause was sudden expansion rather than contraction. If the fracture were examined the walls would be found black, whereas if a piece cracks from dipping in the bath the surfaces of the fracture will be bright. They may be stained by the contents of the bath coming in contact with them, but they will not be black.

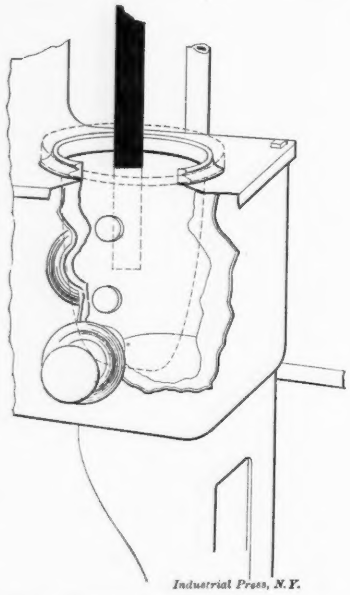
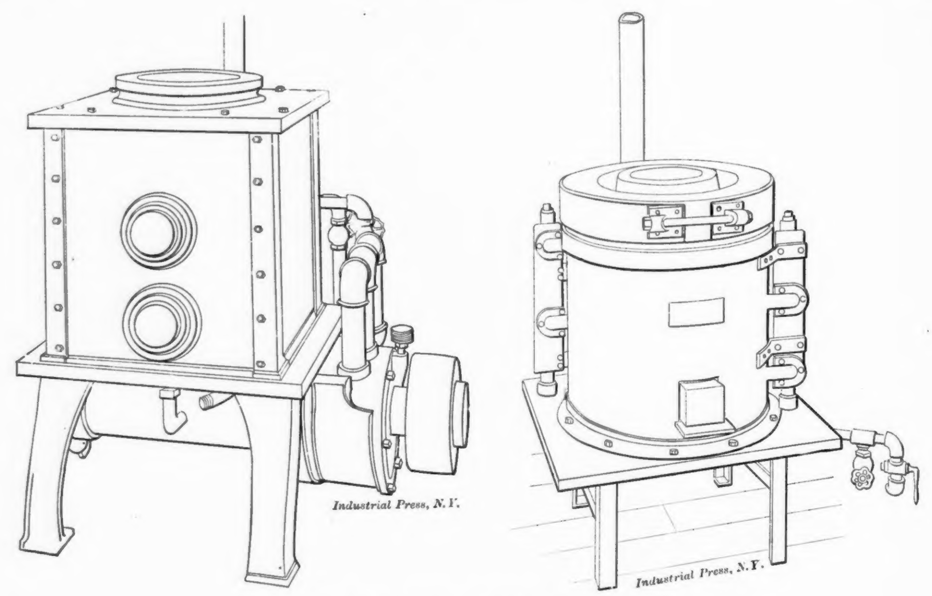


Fig. 2. Heating Steel in a Lead Bath.



Figs. 3 and 4. Types of Gas-heating Furnaces.

Many mechanics object to the use of red-hot lead for heating steel because the lead has a tendency to stick to the steel, which is especially the case in heating tool steel at a low heat. The higher the heat the less tendency the lead has to stick to the steel; but it is not advisable to overheat steel simply to prevent the lead from sticking, and for this reason many have abandoned its use rather than spoil the tools they wished to harden. But there are several dips that may be used which will effectually prevent lead sticking to steel when at the proper hardening heat. Some use a strong solution of salt and water, dissolving all the salt possible in a dish of water; others use a solution of cyanide of potassium and water, dissolving one pound of cyanide in one gallon of water. The cyanide should be crushed or pounded fine and dissolved in boiling water. Great care should always be exercised in the use of this chemical as it is very poisonous. If the solution is not strong enough a greater proportion of cyanide may be added. When using either of the above solutions the work should be dipped in them and allowed to dry before putting it in the lead. For any form of moisture is converted into steam when brought into contact with the red-hot lead, and this will cause the lead to sputter and fly, and wherever these particles strike they are very apt to burn, especially if they strike in the eye. A very good plan is to place the pieces of work, after dipping in the solution, on top of the furnace or on the bricks of the open fire mentioned, allowing them to remain there until dry, when they

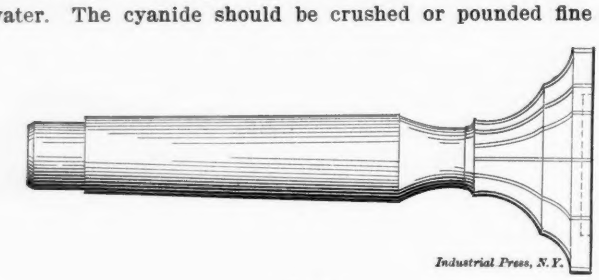


Fig. 5.

When articles having fine teeth such as rotary files, cherries, small reamers, milling machine cutters, etc., are to be heated in lead, a paste may be made that will prevent the lead sticking between the teeth, even when the dips mentioned fail to give good results. The kinds and proportions of the ingredients are given in the following table which is taken from the report of the Chief of Ordnance of the U. S. War Department:

Pulverized charred leather............	1	pound
Fine family flour......................	1½	pound
Fine table salt........................	2	pounds

The charcoal made from the charred leather should be crushed until fine enough to pass through the meshes of a No. 45 sieve.

The ingredients are thoroughly mixed in a dry state, and water is added slowly to prevent lumps until the paste has the consistency of ordinary varnish. The paste is applied with a brush. The articles are placed where they will become thoroughly dry; yet they must not dry fast enough to cause the paste to crack, neither must the pieces be put in the lead until thoroughly dry or the steam generated will cause the lead to fly, as before explained.

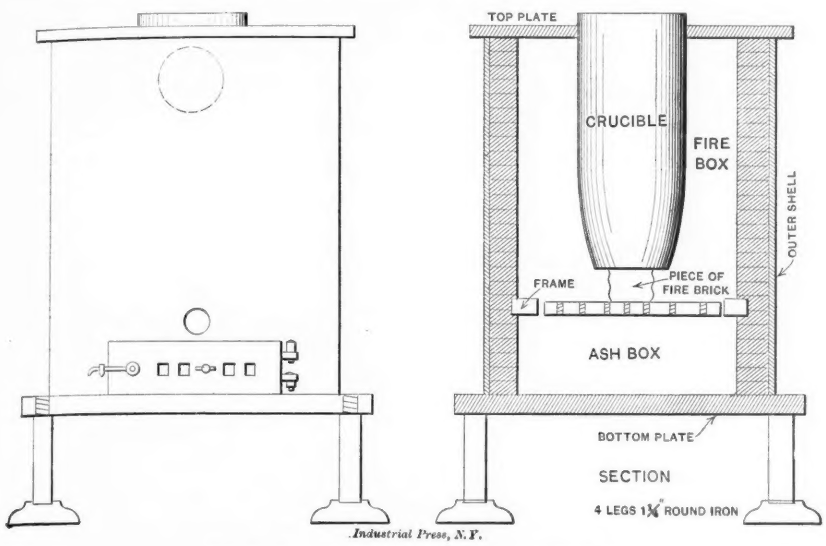


Fig. 6. Heating Furnace for use with Hard Coal.

If large pieces of steel or tools of irregular contour are to be heated in lead and it is not possible to heat nearly to a red in another fire with a slower heat, the article may be immersed in the lead and withdrawn, then immersed again, leaving it a trifle longer than the first time. This operation is to be repeated until the steel has absorbed enough heat to preclude the liability of cracking. Then it may be left until it is heated uniformly throughout to the desired heat.

The question may be asked, If pieces of the shapes mentioned can be better heated in a slow fire until nearly to a red, why not heat to a red and do away with the lead crucible entirely? The object in finishing the heat in the lead is that once the lead is brought to the proper temperature any number of pieces may be heated uniformly, provided proper attention is given the lead. According to my experience, red-

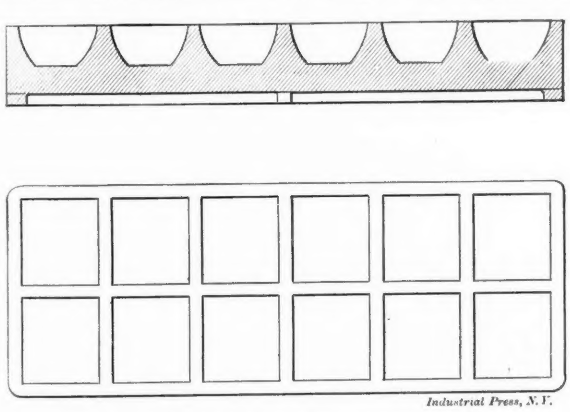


Fig. 7. Mold for Lead when Poured from Crucible.

hot lead provides an excellent means of heating small tools or parts of machines, etc., when the work is hardened in large quantities and when the cost of labor is a factor to be considered. For this method to be a success when considered from a commercial standpoint, it is necessary to provide some means whereby the lead may be kept at a uniform temperature throughout the entire working day, or, at any rate, such portion of it as needed for the necessary amount of work. If a furnace burning illuminating gas can be procured it will be found one of the most satisfactory and most economical methods of heating where the price of illuminating gas is not too high. Very satisfactory forms of gas-burning furnaces are shown in Figs. 3 and 4. If not situated where illuminating gas can be procured at reasonable rates, and it is not considered advisable to instal the necessary apparatus for heating by gasoline or oil, a furnace may be made to burn hard coal, coke or charcoal. While it is not generally considered possible to maintain as even a heat as with gas, yet by exercising reasonable care very uniform results may be obtained.

Fig. 6 shows a sectional view of a furnace intended for burning hard coal. The outer shell may be made of cast iron, although it is often possible to find at a junk dealer's an old boiler which can be bought for a "song." A piece the proper length may be cut from this that answers admirably for the outer shell. A round grate and the necessary frame to support it may be procured from a stove dealer. A grate of the form used in the ordinary cylinder parlor stove answers every purpose. The frame should be attached to the shell or blocked up sufficiently high from the plate which supports the outer shell to allow the grate to be turned in dumping the contents of the furnace. It is necessary to cut an opening in the front of the shell at the bottom, which should be covered with a door containing a sliding damper. This door is necessary in order to remove the ashes. The inside, from the frame to the top of the shell, should be bricked with circular fire brick, or, if possible, with a stove lining of the proper size. Over the top must be placed a plate having a hole in the center one-half inch larger than the size of the top of the crucible to be used. A smoke pipe must also be provided, to carry off the smoke and gas from the fire. This can be connected with the shell at the top on the back side of the furnace, and should also be connected with a chimney and provided with a damper for use in regulating the draft. The plate covering the top of the furnace may be cast in two pieces, having more than half the hole in the part that goes at the back. The smaller or front half may be moved forward, thus affording an opening to feed the coal to the fire. The object in having more than one-half the hole in the back part of cover is to prevent the crucible from tipping over when the front plate is moved if there were not sufficient coal in the fire to support it. It is also necessary to rest the crucible on a piece of fire brick as shown in Fig. 6. If a black lead crucible is used to hold the lead, much better service can be obtained if the crucible is annealed before using. In order to do this the crucible should be placed in some fire where it can be heated all over to a red heat. It should then be removed and placed where no current of air can strike it and allowed to remain until cold. It will then last much longer than if used without annealing.

It is necessary to remove the lead from a black lead crucible before it cools and solidifies, or the crucible will crack when heated again. When doing this it is dipped out with a ladle until the crucible is nearly empty, when it may be removed with tongs and the balance of lead emptied out. As it is necessary to put the lead in the crucible in small quantities when heating, it is advisable to have a mold made, of the form shown in Fig. 7, to turn the lead into when removing from the crucible. This mold resembles a muffin pan, and the compartments serve to cast the lead in pieces of the proper size to put in the crucible when reheating.

If the above instructions are carefully followed excellent results will follow the use of this method of heating; but if scrap lead or pig lead of an inferior quality is used then trouble will surely result. My advice would be: Rather than to attempt doing things by halves, do not attempt the use of red-hot lead for heating tool steel.

* * *

A foreign writer, Aug. F. Weiner, states that the addition of a small quantity of ferro-vanadium has the property of raising the tensile strength of mild steel by from 50 to 66 per cent.—*Sparks from the Anvil.*

EARLY MACHINE SHOPS AND MECHANICS.

HISTORICAL NOTES ON THE DEVELOPMENT OF THE MACHINE SHOP DURING THE EARLY PART OF THE NINETEENTH CENTURY.

The last century was remarkable for being a distinctly mechanical era. At its beginning the machine shop scarcely existed except in the most primitive form, and machinery of any but the crudest types was practically unknown. The clock and the watch of that time undoubtedly represented the highest development of any mechanism built for specific purposes. Agriculture and other industries were being pursued in almost the same manner as at the beginning of history. Transportation on land was effected by rude carts or wagons drawn by animals and on water by vessels propelled by sails or oars. The steam engine was just beginning to be recognized as a prime mover, but was generally unknown.

At the end of the nineteenth century, how are the conditions changed? The implements and machines for agriculture alone are almost unnumbered. The farmer sows the seed, reaps the harvest and threshes it by machinery. The steamship, locomotive and trolley car have come to be necessities for transportation. The steam engine is the prime mover of thousands of mills and factories and does the work of myriads of horses and millions of men. In every industry that then existed nearly every feature has been changed and many new industries have sprung into existence as a result of general mechanical development.

The building of machinery requires machine tools and the machine shop. The construction of the first steam engines, when the machine shop was in its infancy, were undertakings attended by almost unsurmountable difficulties. The machine shop became a necessity and has so developed that it is now an important factor in every industry and directly or indirectly influences every trade and profession.

In 1800 the pole lathe was the principal machine tool in use, although there were a very few lathes in existence having a rotating spindle driven by a band from a flywheel turned by a foot treadle, and some other minor improvements. The pole lathe was about the simplest imaginable affair to be dignified by the name of machine, being little more than the primitive lathe of the ancient Egyptians. It consisted of a wooden frame set on legs and carrying a pair of poppets which held the dead centers on which the work revolved. The work was alternately rotated forward and backward by a cord wound around the work and fastened at one end to a pole or lath (from whence the name lathe) secured overhead. The lower end of the cord was usually made into a loop through which the operator thrust his foot to exert the motive power. A foot treadle was sometimes employed instead of the loop, the end of the cord being secured to one end. The disadvantage of having the work turn first forward and then backward led to the employment of means for making the rotation continuous. The first steps in this direction appear to have been by winding the cord around the work so that the work would be turned forward on the down stroke of the treadle, and when the pressure was removed so that the pole or lathe returned to its original position, the motion of the piece being turned would continue in the same direction on account of the peculiar arrangement of the cord. This scheme, however, never became popular as a large portion of the power exerted was lost in friction of the cord. With such a tool the turning of a piece of metal with any degree of accuracy was extremely difficult, since the operator was obliged to stand on one foot and manipulate his tool against the surface of work alternately turning in opposite directions.

The first rotating spindles for lathes were made from square iron turned for the front bearing and threaded on the end for the chuck. The thread for the chuck was sometimes made internal but the usual practice was to make it external, as now holds. The tail bearing of the spindle was formed by a pointed setscrew held in the back poppet head and engaged in the end of the spindle. The spindle thus turned in a box at the front and on a pivot at the back end. This arrangement had two advantages: It afforded a simple means for taking the thrust and also taking up the end play, and reduced the frictional resistance below that which would have resulted with the shaft running in two boxes. When the latter construction was finally adopted to obtain greater stability, the back bearing was kept as small as possible to make the shaft run easily. The influence of this practice is seen in most modern engine lathes to-day when the reason for it no longer exists.

The shears of the old time lathes as well as all other parts except the spindle and centers were made of wood. The head poppet being made in two parts framed into the bed, it was almost impossible to keep the spindle in alignment with the tail center. To obviate this trouble J. J. Holtzpffal, England, made a headstock in 1794 of cast brass having its base and the front and rear bearings one integral part. This was found to be such an improvement that headstocks were subsequently made of cast iron by him. The patterns were made so that the sections of the castings were generally of uniform thickness, as is the present practice, instead of following the square shapes of the wooden parts made by the carpenter.

The most important improvement, however, ever made in the lathe and which is a distinguishing feature of every modern machine tool except the drill press, was the invention of the slide rest by Henry Maudslay in 1794. Maudslay was at this time a workman in the shop of Joseph Bramah, generally known as the inventor of the hydraulic press. This

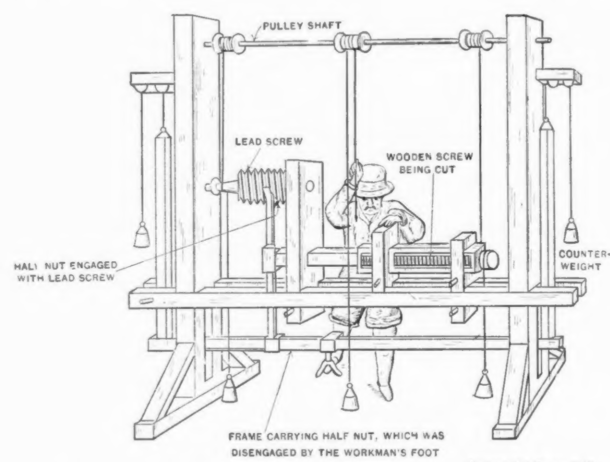


Fig. 1. Jacques Berson's Wood Screw-cutting Lathe, 1569.*

invention replaced the cutting tool held in the uncertain grasp of the workman's hand by a tool held in a hand of iron and it furnished the means of guiding the cutting point in mathematically straight lines. The slide rest made accuracy possible and enabled the production of perfect cylinders in the lathe and later the production of accurate plane surfaces in the planing machine. The slide rest at first was generally opposed and ridiculed by the workmen who nicknamed it "Maudslay's go-cart," but it was not many years before it became commonly used, as was its manifest destiny. While the invention of the slide rest was undoubtedly original with Maudslay, it appears to have been anticipated by many years in France, having been illustrated in the French Encyclopedie published in 1772. The latter device differed materially from the invention of Maudslay and as it had apparently never been developed beyond an experimental stage, or if so, had been allowed to go out of use, it is to Maudslay that we should give the credit for undoubtedly the greatest improvement ever made in machine tools.

The wood-working machinery erected in Portsmouth dockyard in 1807 under the direction of Maudslay, marked an important step in labor-saving machinery and had an important effect on the future design of metal-working tools. The machines were designed by Brunel and Bentham principally for the production of tackle blocks and when completed enabled 10 men to do the work of 110 men and in a far superior manner. These machines are said to have effected a saving to the English Government of about $120,000 annually. The making of tackle blocks was an important part of the equip-

* The illustrations accompanying this article are taken from "Turning and Mechanical Manipulation," by Charles Holtzpffal, published in 1843.

ment of a man-of-war, as a 74-gun ship had 1,400 blocks of various sizes.

It is thus apparent that at the beginning of the nineteenth century the lathe, while yet a very crude affair, was with Maudslay's invention of the slide rest, the progenitor of the wonderful machine tools which are produced from, and in turn make possible, the modern machine shop.

The importance of the screw as a machine element and as applied to studs and bolts for fastening machine parts together, was early recognized, but no means had ever been devised for securing ease of production and uniformity of

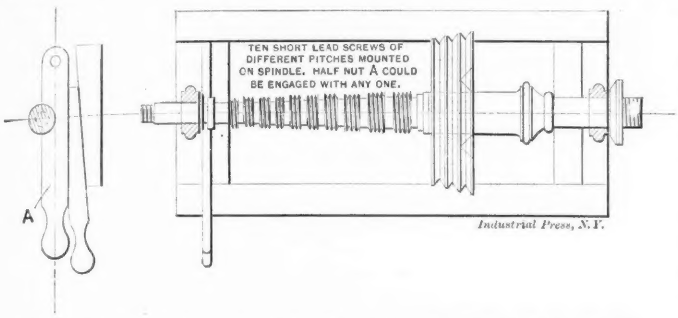


Fig. 2. Early French Mandrel with Ten Leads of Thread for Thread Cutting.

product until the invention of the screw-cutting lathe. To whom this honor is due does not appear to be exactly clear. The first mention of a lathe arranged for screw cutting is that of Jacques Berson, a Frenchman who had a primitive rig arranged for cutting spirals in wood and which was subsequently arranged to cut threads in metals. A cut of this device is to be found in some old books which give a dim idea of its operation although it is hard to understand how such a crude tool could have been operative. In 1648 engravings were published in Rome of two curious machines, called by courtesy lathes, for the production of plane, spherical and hyperbolic mirrors. The cutting tool in these machines was held in a sort of carriage mechanically controlled so that if need be the same machines could have been adapted to the cutting of helices although there is no evidence that this was ever done. Another lathe referred to by historians is that of Joseph Moxon, about 1680, for the production of "swash" work, which was then very popular. It is said that Moxon made these lathes for sale and that they were much

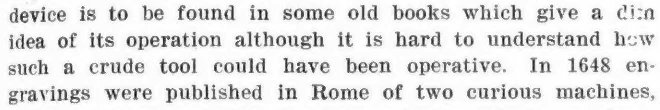


Fig. 3. Allen's Device for Originating Screw Threads for Astronomical Work.

sought after, as they were well made and generally excellent tools. Again, there is no evidence to show that they were specially adapted to the production of screws, although the tool was mechanically controlled and could have been arranged to secure the result with little more complication. A machine appears to have been used by the early watchmakers for the production of screws, working on substantially the same principle as the screw-cutting lathe, although it was adapted for the production of only one lead. The face plate on the spindle (it being a rotative spindle), was a gear and meshed in another gear mounted on a screw running parallel with the shears, as in the modern tool. The carriage was furnished with a nut engaging with the screw, so that the production of screws of various diameters but of uniform lead was possible.

Another method which appears to have been extensively used, was that of having a thread cut on the spindle which was arranged to slide longitudinally in its bearings. The work was held in a chuck and the tool remained stationary, as in Healey's lathes of 1804. A nut being engaged with the screw on the spindle, the same lead was generated on the piece held in the chuck. One elaborate machine is illustrated in Holtzpffal's "Turning and Mechanical Manipulation," in which the idea was carried out so that ten different leads could be cut in this manner, ten screws being cut on the spindle along a portion of its length and ten half-nuts with supporting keys any one of which could be engaged as desired. It is probable, however, that this machine was built after 1800.

The various means adopted by the old-time mechanics for the production of original screws, are very interesting but can be only briefly touched on here. One was to wrap a strip of paper around the blank cylinder of metal or wood as the case might be, so that its edge would form a helix of the desired pitch. This edge gave the workman his guide for the cutting tool when the piece was mounted in the lathe. Imagine cutting threads in such a manner!

It is recorded that Anthony Robinson at the Soho works of Boulton & Watt made in 1783 an original screw seven feet, six inches long and six inches diameter with a triple square thread, pitch not given. The thread was laid out by wrapping

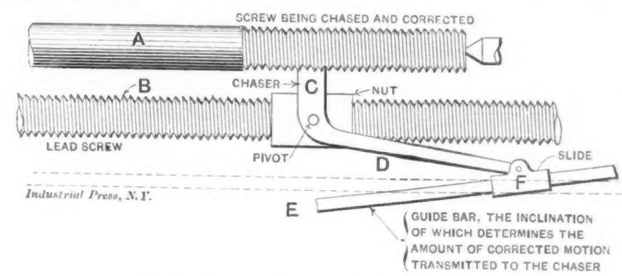


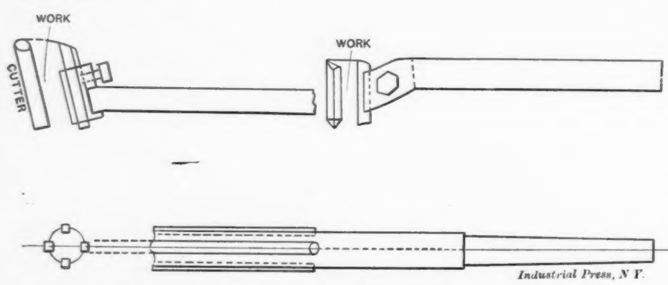
Fig. 4. Maudslay's Thread Correcting Device.

a sheet of paper around the blank so that the edges when trimmed just met. The paper was then removed and the threads laid out as lines running across the paper at the proper angle, Robinson evidently understanding that a screw is the same as a right triangle wrapped around a cylinder so that the hypothenuse is the helix, the base the circumference and the altitude the pitch.

After the lines were laid out and inked, the paper was replaced on the blank and the lines pricked through the paper into the metal underneath. The paper was then again removed and one thread, shallowly chipped and filed out. The partly formed screw was then stood on end, being thrust through a shallow square cast iron box. The hole in this box around the cylinder being luted with clay, it was filled with melted lead, and when the lead cooled, the cast iron box formed a rude nut on the unfinished screw. A cutting tool was rigged on the face of the box with proper adjusting devices so that it could be fed into the cylinder and then the box having levers attached was handed around by the lusty workmen. In this manner the other grooves were cut of the same pitch as the first and the first finished to the desired depth. The recital of these operations gives some idea of the tremendous difficulties encountered in machine construction at the beginning of the century.

The problem of accurate screw cutting was one that peculiarly appealed to Maudslay, as he had a keen appreciation of the desirability of such a condition and of the immense advantages to be secured by its solution. Some of Maudslay's efforts in the line of accurate screw cutting after becoming the proprietor of a shop would not be half bad now if the records can be believed. He is said to have made a screw for astronomical work 60 inches long, 50 threads per inch, on which was screwed a nut 12 inches long, so that 600 threads were engaged at the same time. The old timers evidently had a keen appreciation of the law of averages, as is shown by the use of the long nut. The importance of standard planes

and surface plates was appreciated by Maudslay, who supplied them in numbers in his shop and required all plane surfaces of importance to be perfected by their use. He also believed in exact measurements and had a bench micrometer called the "Lord Chancellor," as it was the court of last resort in the matter of measurement and by it the system of gages used was derived. The invention of the micrometer did not originate with Maudslay, but is claimed for William Gascoigne in 1648.



Figs. 5 and 6. Inserted Cutter Lathe Tools used in Portsmouth, England, about 1830; and Inserted Cutter Reamer of about the same date.

Maudslay's work in the production of accurate screw threads seems to have been principally along the lines of generating a thread by a tool set at the required angle for the thread and after getting one perfect helix, to reproduce it by the combined angular position of the cutting tool, together with a guide finger working in the helix already cut. He evidently considered that a mechanically operated carriage introduced an element of uncertainty which was fatal in the days of slender and inaccurate construction.

One thing is certain that although Richard Roberts brought out an improved screw cutting lathe in 1816, the art of cutting threads by a mechanically controlled carriage did not for many years become general. There are old mechanics living to-day who remember well the trials and struggles of their apprentice days when learning to use the chaser for cutting a thread. The tyro was very likely to produce a thread irregular in travel, having a wavy appearance and aptly characterized as "drunken."

The work of Maudslay in the production of accurate screw threads was followed by that of Clement and Whitworth in England and Sellers in the United States, to the latter two of whom we are indebted for the modern system of interchangeable screw threads in England and the United States.

Joseph Clement of Manchester was the first to make taps having their thread numbers in proportion to the tap diameters. He was also the originator of the form of tap having the shank smaller than the hole tapped, so that the tap could be passed through without backing out. Clement's taps were fluted by a revolving cutter similar to the method now fol-

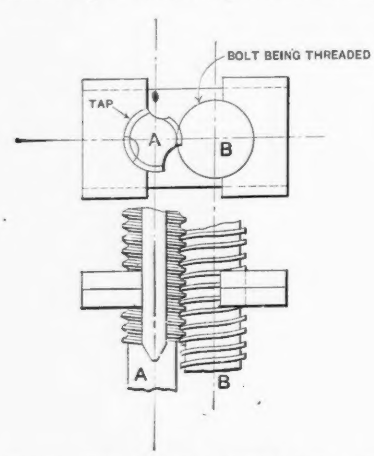


Fig. 7. Early Method of Cutting Left-hand Screws with a Right-hand Tap.

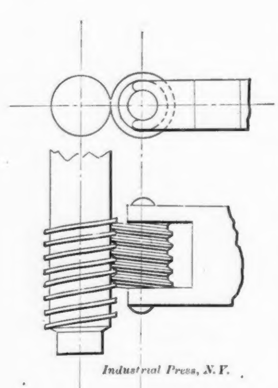


Fig. 9. Showing that Thread Rolling is not a Recent Invention

lowed. This was in 1828, but the use of the milling cutter or circular file as it was then known seems to have been known many years previously. There are records showing that the milling machine was used in this country in 1818 at Middleton, Conn., and mention is made of the use of toothed cutters in 1664 by a Dr. Hooke, for cutting gear wheels. It is also recorded by Chas. Holtzapffel that inserted cutter thread and turning tools for the lathe were in use as early as 1830. The cuts given show that they were very similar to those now used.

In the construction of the first lathes having beds of metal, great difficulties were met in getting the beds straight and accurate as the planing machine was practically unknown. To get a form that would require a minimum of fitting, the beds appear to have been at first made in triangular section. All fitting and accurate work was thus confined to one angle which also had the effect of holding the slide rest in position both vertically and laterally.

The invention of the metal working planer is variously ascribed to Roberts of Manchester, Fox of Derby, Matthew Murray of Leeds, Spring of Aberdeen, Clement and Rennie of London, who all appeared to have had some sort of planing machines at work from 1814 to 1820. Whether Murray's claim to the invention of the iron planer is valid or not, it is certain that he was a mechanic of no mean order as he designed and built a commercially successful locomotive in 1812 for the Middleton Colliery Tramway, Leeds, which ran for nearly fifty years before being relegated to the scrap heap. This locomotive burned coal.

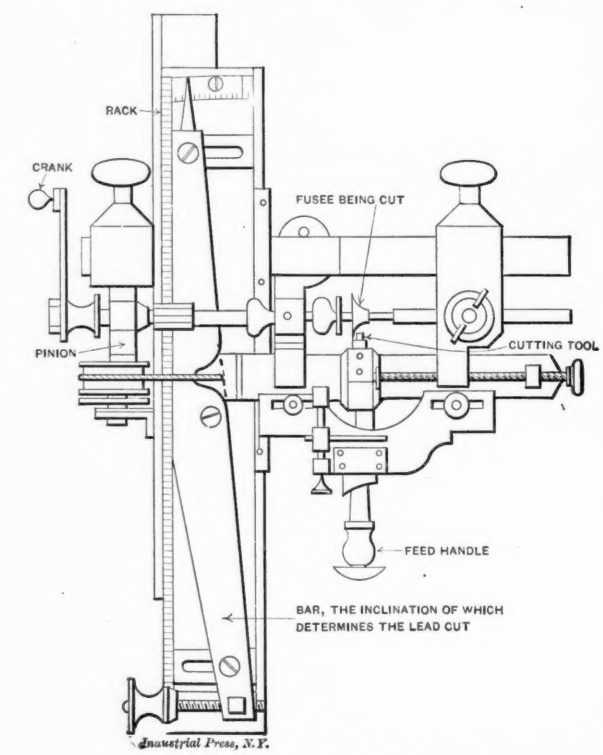


Fig. 10. Le Lievre's Device for Cutting Fusee Threads.*

Joseph Bramah patented a planer in 1802 with a revolving cutter, but it was primarily designed for wood and appears to have been used for this purpose. There are records showing that Nicholas Torq, a French clockmaker, used a metal planer in 1751 for *boring* pump cylinders, apparently being under the impression that they could be made more accurate in this manner than by a revolving cutter. It is to Clement, however, that the honor of bringing out the first iron planer on the same lines as the tool is now built, evidently belongs. He had a machine in operation for planing the triangular bars for lathes in 1820 and built a more elaborate one of which a description was published in 1825. The cutting tool was stationary relative to the work and was held in a slide rest which was fed across the table. The tool cut on both strokes. The table or platen was mounted on rollers. The planer would take six feet square through the uprights. For ten years it is said to have been the only tool of the kind in existence. For much of the time it was kept in operation night and day on piece work. The charge for its services was over $4 per square foot of area planed, but at these enormous prices the machine was able to earn only (!) $100 per day, showing an area planed of about 25 square feet. The authority for this remarkable statement is "Industrial Biography," by Samuel Smiles, but we are inclined to question

* A device for cutting screws working on the same principle has recently been patented.

the accuracy of the price received for planing. As it was possible to have surfaces chipped and filed true for $1.50 per square foot at about the same time, it is not probable that Clement could charge three times as much for the same work done on the planer.

It is also stated that Clement used planer centers on these machines so that he was able to produce both flat and cylindrical work on the machine. Joseph Whitworth radically improved the planer by the application of the screw drive in 1839 and again Sellers of Philadelphia further improved it.

James Nasmyth, a pupil of Maudslay's, was an improver of machine tools and an inventor of a number. He is credited with the invention or adaptation of the slotter for metal work in 1836, the first machine being a modification of a machine for mortising holes in wood, designed by Maudslay. The invention of the flexible shaft for drilling in 1829, the keyseater in 1836, the crank driven shaper in the same year, the reversing or tumbler gear for changing the feed direction in lathes in 1837, the self-adjusting or spherical bearing for shafts in 1838, a tapping square for holding taps square with the work in 1840 and an end mill for keyseating shafts in 1847 are credited to him. In 1848 he made a punch for punching boiler plates having a skewed face to give a shearing cut. His invention of the steam hammer in 1839 was an important advance in the art of blacksmithing and made a radical change in forging operations, making work possible that had never before been attempted. The increase in the size of forgings and other changes in machine construction materially affected machine tools and led to radical changes in design. So decided were these changes that the machine tools made by John G. Bodmer in the few years from 1839 to 1841 contained almost every improvement of importance now found in modern tools.

It is thus apparent that the early development of machine tools took place in England, the English mechanics having anticipated practically every form of machine tool and method of working metals. The changes that have since taken place have been with few exceptions more in methods and minor changes than in radical ideas.

Early Machine Shops in the United States.

The early history of the machine shop in the United States is very uncertain, undoubtedly because the industry had never become of marked importance until well along during the past century. The first mention of a machine shop in what is now part of the United States that the writer has found is that of the Saugus Iron Works, Lynn, Mass., which were established in 1642, in which year they made the first iron casting poured in America, being an iron kettle which is yet preserved. The Saugus Works included a machine shop in which the first hand fire engine built in America was constructed for the city of Boston in 1654. The castings for this and other machines were made from bog iron ore and were made directly from the metal flowing from the blast furnace, the cupola for remelting the iron not being developed until 1790.

A machine shop was erected in the last years of the eighteenth century near Belleville, N. J., in conjunction with the Hornblower pumping engine imported from England for draining the copper mine at that place. Whether the machine shop was primarily intended to keep the engine in running order is not stated, but it apparently did outside work as we are informed that a pumping engine was built here for the city of Philadelphia in 1800. The engine when completed occupied the present site of the City Hall at the junction of Broad and Markets Sts. The steam cylinder was 38½ inches in diameter by 72 inches long, and its construction was a most difficult job with the crude and inefficient tools then in use. The boring of the cylinder took from the 9th of April, 1800, to about the middle of the following August, two men being in constant attendance night and day. This seems an incredible statement, but it is apparently sustained by the records at hand. It is highly probable that the cylinder casting, like most of the cast iron of that period, was extremely hard and very untrue, so that with the scraping cuts possible with the boring appliances used the amount of metal to be removed consumed an astonishingly long time.

In early engine construction as in other machines, as little machine work was incorporated as possible. Plane surfaces were tabooed in most shops, as they had to be surfaced by the chisel and file. The valve seat was the most important plane surface considered strictly necessary. The same general condition held in regard to bored holes. Such was the difficulty in boring true holes that on some of the early engines built, the cylinder was the only piece bored. The crank was cast with octagonal holes for the shaft and crank pin and was fitted to the shaft by thin wedges driven in so as to bring it approximately square with the shaft. The spaces unfilled with the wedges were filled with a cement made from iron borings and sal-ammoniac. The crank pin was fitted in the crank eye in the same manner. To make the throw correct for the stroke of the cylinder, it was often necessary to have the center of the working surface of the pin eccentric with the portion fitted in the crank.

The connecting rod was forged to shape and the holes for the strap bolts drifted out by the blacksmith as were the holes for the adjusting keys. The file was used for finishing.

A machine shop was started in 1801 by Robert McQueen on Duane St., New York. He was probably the first to make a specialty of building steam engines in the United States. After the success of the Clermont in 1807, Fulton established a shop in what is now Jersey City, where he built the Car of Neptune and finished steam engines, the iron castings being machined in New York by McQueen and Youle and the brass castings by James P. Allaire. What was subsequently the Allaire Works was started by Allaire in 1816. They became famous as builders of marine engines and other machinery. This firm had what is thought to be the first planer in America, built for fluting rolls and was in use in 1828. Such a then important business as the Port Richmond Iron Works, Philadelphia, Pa., had no iron planer until 1838. One of the first industries in the United States that stimulated the use and development of machine tools was the manufacture of cannon at the Fort Pitt Works, Pittsburg, Pa., which were established in 1814. A boring mill was erected at this date and cannon were bored and finished, the motive power being furnished by horses. At these works the famous Rodman cannon were subsequently made.

One of the early machine shops which had an important place in the early part of the century as machine tool builders was Silver & Gay, North Chelmsford, Mass., established in 1832. They built their first planer in 1836, having a capacity of 3½ feet square and driven by a chain. This is thought by some to have been the first planer built in America, but was not the first one in use, as shown in a previous paragraph. This planer had one V-way and one flat way set on directly on a granite bed. The table was driven by a heavy flat chain very similar to modern sprocket chains. This remarkable tool was still running in 1896. In this shop was built a 16-foot boring mill about 1840, having three heads, all of which had power feed. The center head was arranged to act as a slotter for keyseating the hubs of pulleys after they had been turned and bored. This firm built lathes, for their own use at least, having the usual chain feed mechanism commonly in vogue at that time for moving the carriage, but in addition some of them had power cross feed, one referred to in MACHINERY, February, 1896, being an example, and this was thought to have been built shortly after the firm started in business. This lathe was of about 48-inch swing and had a granite bed on which were mounted the cast iron shears. The tailstock had a set-over made on about the same plan as holds in modern engine lathes for turning tapers. Drill presses with power feed for both table and spindle, well adapted for heavy work, were built and sold by them between 1840 and 1850. They were pioneers in the building and development of the milling machine, having made them for sale as early as 1841. Frederick W. Howe afterward actively identified with the milling machine and turret lathe, learned his trade with this firm, finishing it about 1854. A spur gear cutter was built and sold to the Stark Mills by this firm in 1839 and one which was kept in their own shops in 1841. The work arbor of this machine was vertical, the index wheel being mounted below the upper part of the frame. The cutter spindle was on a

horizontal axis, but was capable of being swung around sideways for gashing wormwheels and backward for bevel gears. Whether it was successfully used for cutting bevel gears is not positively known. The planing of bevel gears was taken up and a machine built for the purpose in the early fifties. The frame was made of wood with the working parts of iron and steel. The cutting tool was guided by a former and swiveled so as to cut both ways. In this machine the former was set so that the motion derived from its contour was reduced at the tool point, thereby reducing instead of multiplying any inaccuracy and also tending to make the former, which was of wood, last longer. For this machine the Silver & Gay Co. were awarded a gold medal in 1857 at the Middlesex Mechanics' Association.

* * *

HOLLOW FORGINGS.*

HOW NEW METHODS HAVE IMPROVED HEAVY FORGINGS

There are two ways of making a forging hollow. The ordinary way of getting rid of the center of a forging is simply to bore it out. After boring it is tempered, and thus the strength is restored which was taken away with the material that was in the center.

Another way of getting rid of the center of large forgings is to forge them hollow. A person who has not considered the subject carefully would naturally think that the first thing to do in making a hollow forging would be to cast a hollow ingot. There are various defects which occur in ingots, however, the most serious of which are "segregation" and "piping," and it is in the center and upper portions that those defects occur. If an ingot were to be cast hollow a solid core of fire brick or similar material would replace the center metal, and instead of one on the outside, there would be two cooling surfaces, one on the outside and one around the core, and the position of last cooling would be transferred to an annular ring midway between those surfaces where the "piping" and "segregation" would collect. This would not be satisfactory because the metal there, is what must be depended upon for the strength of the hollow forging. It is necessary, therefore, to collect the "piping" and "segregation" in the center and at the top, where metal has been added to the original ingot for the purpose. Then, having cut off the top and bored out the center, the "piping" and "segregation" are entirely eliminated. and what is left is as sound and homogeneous a piece of steel as can be obtained.

After the hole has been bored in the ingot, the next process is to reheat it, and, as before explained, this process is not as delicate a one as if the ingot were solid. The heat affects the center equally with the exterior and the two expand together and the danger of cracking is not incurred. When the ingot is reheated a steel mandrel is put through its hollow center, and subjecting the two to hydraulic pressure the metal is forced down and out over the mandrel. Thus an internal anvil is practically inserted into the forging and there is, therefore, really much less than one-half the amount of metal to work on than if the piece were solid.

When the work of shaping is completed the forging is reheated to the proper temperature and then either annealed in the usual manner or plunged into a tempering bath of oil or brine to set the fine grain permanently that has been established by the reheating. A mild annealing follows, to relieve any surface strains that may have been occasioned by the rapid cooling.

Hollow forgings oil tempered and annealed are considered the best grade of forgings made, and any forgings made otherwise, although they may be suitable for the service to which they may be applied, cannot be looked upon in any other manner than as of an inferior grade.

That steel forgings of such high grade were being manufactured for commercial purposes in this country was first brought to the attention of manufacturers generally at the World's Fair in Chicago. Here were exhibited stationary engine forgings which compared favorably with those sent over by European forges. The Ferris wheel shaft, 45 feet long and 32 inches outside diameter, with a 16-inch hole through it, represented the largest shaft made up to that time. The soliciting of orders for such forgings, however, at once aroused the latent prejudice still existing against steel forgings, and the prices demanded being somewhat in excess of those which wrought iron or ordinary steel forgings could be obtained for prevented at first the very rapid introduction of this product into the commercial field.

Difficulties Encountered in Introducing High-grade Forgings.

It hardly seemed necessary to explain to an engineer or any one authorized to purchase, and therefore presumably competent, that if he wanted material to sustain severe usage in the nature of alternating stresses, to which all forgings are subjected, he should select a material possessing a very high elastic limit. And yet it was not unusual to find that those very people preferred to use wrought iron for their engine crosshead and crank pins and shafts in preference to steel, because, as they said, "steel being crystalline is brittle and snaps off suddenly under such services as that under consideration, while iron, having fibre, is tougher and yields before breaking." Most of these men knew better, but had not given the subject sufficient thought or they would have perceived that their statements were not consistent. They said that the steel connecting rods they had tried had broken off short without any warning, while rods made of wrought iron had simply bent up, and after having been straightened out were replaced as good as new.

These people did not stop to think that a steel rod that broke off short had done so at its ultimate strength or under a stress of from 80,000 to 90,000 pounds per square inch, whereas the iron rod which had doubled up had done so at its yielding point of 25,000 to 30,000 pounds per square inch. In other words, their engines with wrought iron rods were failing all over the country under loads about one-third what they were standing up to when supplied with steel rods, yet the men were blaming the steel for helping them out of their troubles.

Then again they complained that steel shafts and crank pins heated up, while wrought iron ran cool. When it was proved to them that laboratory experiments showed the coefficient of friction of these metals to be the same and that any difference in heating was caused by local circumstances, such as poor lubrication, excessive pressure, etc., they said they did not care for laboratory experiments. They had an engine in one place with a steel shaft that never would run cool. while another with a wrought-iron shaft had never given any trouble, and they were passing judgment on their own experience. Persistent exposure of these fallacies gradually brought about a change in sentiment.

"Cold Crystallization" does not Occur.

It took a long time to persuade people who had seen broken forgings which showed a coarse crystalline section that the metal had not crystallized from shock or vibration in service, but had been forged in such a manner that the crystalline condition of the ingot from which the forging had been made had not been changed by the forging process or by subsequent heat treatment. And these are the people even now who consider themselves conservative, who would rather have their forgings made of a mild steel which is weak than of a higher carbon steel which is strong, simply because the old ideas are not yet eradicated from their minds. Tests were made at the Government testing bureau at Watertown by rapidly bending bars forward and backward within their elastic limit with the following results, and these have given engineers an idea of the comparative endurance of wrought iron, steel and nickel steel, in such service as that to which crank pins, shafts, etc., are subject:

TESTS OF STEEL UNDER REPEATED STRESSES.

Under a Fiber Stress of 40,000 Pounds per Square Inch.

Wrought iron breaks after	50,000	alternations of stress
.15% carbon steel " "	170,000	" " "
.25% " " " "	229,000	" " "
.35% " " " "	317,000	" " "
.45% " " " "	976,000	" " "
3¼% nickel steel carbon .25 to .30%	1,850.000	" " "
4½% " " " .25 " .30%	2,360,000	" " "
5½% " " " .25 " .30%	4,370,000	" " "

* Extract from paper read by H. F. J. Porter, before the Engine Builders' Association.

Engineers and those whose duties it is to purchase forgings have been led to see that they should specify definitely the strength that they wish the material to possess and then to follow up the specifications by inspection to insure receiving what has been ordered.

During the past few years a series of specifications has been drawn up and adopted by the International Association for Testing Materials, which is composed of engineers, manufacturers, companies, associations, societies, and any individual or organization interested in obtaining standards. The standard specifications for forgings are herewith given for convenient reference and the physical properties mentioned are obtained from test bars drilled from a full-sized prolongation, forged to one end of the forging, these test bars being of the United States Navy standard size, ½ inch diameter and 2 inches long between gage marks.

REQUIREMENTS AND GUARANTEES FOR STEEL FORGINGS.

Class of Steel Forging		Tensile Strength. lbs. per sq. in.	Elastic Limit lbs. per sq. in.	Elongation, per cent.	Contraction of Area. per cent.
Nickel Steel.	(1)	95,000	65,000	21.00	50.00
Oil Tempered	(2)	90,000	60,000	22.00	50.00
	(3)	85,000	55,000	24.00	45.00
Nickel Steel, Annealed.	(4)	80,000	50,000	25.00	45.00
	(5)	80,000	45,000	25.00	45.00
	(6)	80,000	45,000	24 00	40.00
Carbon Steel, Oil Tempered.	(7)	90,000	55,000	20.00	45.00
	(8)	85,000	50,000	22.00	45.00
	(9)	80,000	45,000	23.00	40.00
Carbon Steel, Annealed.	(10)	80,000	40,000	22.00	35.00
	(11)	75,000	37,500	23.00	35.00
	(12)	70,000	35,000	24.00	30.00

Dimensions of solid and hollow forgings in which the physical qualities mentioned in the above table are guaranteed:

(1) Solid or hollow forgings, no diameter or thickness of section to exceed 3 inches.

(2) Solid forgings of rectangular sections not exceeding 6 inches in thickness, or hollow forgings, the walls of which do not exceed 6 inches in thickness.

(3) Solid forgings of rectangular sections not exceeding 10 inches in thickness, the walls of which do not exceed 10 inches in thickness.

(4) Solid or hollow forgings, no diameter or thickness of section to exceed 10 inches.

(5) Solid forgings, no diameter to exceed 20 inches, or thickness of section 15 inches.

(6) Solid forgings over 20 inches diameter.

(7) Solid or hollow forgings, no diameter or thickness of section to exceed 3 inches.

(8) Solid forgings or rectangular sections not exceeding 6 inches in thickness, or hollow forgings, walls of which do not exceed 6 inches in thickness.

(9) Solid forgings of rectangular sections not exceeding 10 inches thickness, or hollow forgings, walls of which do not exceed 10 inches in thickness.

(10) Solid or hollow forgings, no diameter or thickness of section to exceed 10 inches.

(11) Solid forgings, no diameter to exceed 20 inches or thickness of section 15 inches.

(12) Solid forgings over 20 inches in diameter.

* * *

SAVING FROM NEW TOOLS AND METHODS.

At a meeting of the Western Railway Club Mr. M. K. Barnum gave illustrations of the amount of money that is wasted every day by the lack of up-to-date tools. He contends that if an old machine can be replaced with a new one which will do enough more work, or do the same work with enough less labor, to represent a saving in money equal to 5 per cent. per annum on the investment, it should be entitled to careful consideration. As this is the basis on which other railroad improvements are figured, how easy ought it to be for mechanical men to obtain approval on a requisition for a machine which will save from 10 per cent. to over 100 per cent. per annum on the investment.

Several examples were instanced by Mr. Barnum of the saving through new tools and methods, which are given below. They are from "actual practice."

1.—In a railroad shop employing about 160 machinists there were no horizontal boring machines for such work as boring driving box brasses, rod brasses, rocker boxes, air pump cylinders, etc., and all such work had to be done in lathes, milling machines or drill presses.

After repeated conferences and much argument accompanied by estimates of savings that would result, permission was obtained to order a No. 2½ horizontal boring and drilling machine with 4-inch bar and latest attachments. It has been in use about 18 months and shows earnings by money saved as follows:

Original cost of machine installed ready for work..	$1,696.00
Average savings per year as compared with old manner of doing same work	900.00
Interest on investment	53 per cent.

It formerly required three hours to bore a driving box brass for a 9 x 12-inch journal in a milling machine and about four hours to do the same work in a lathe, whereas they are now bored in one hour in the horizontal boring machine. Rocker boxes, tumbling-shaft boxes, etc., are done in one-half the time formerly used.

In boring air pump cylinders it was formerly necessary to take the pump apart and set and bore each cylinder separately, requiring from two to three hours each. In the new machine it is possible to bore all four cylinders of a New York pump at one setting, without taking them apart, which requires but an average of one hour for each cylinder. In addition to the saving in time, much greater accuracy is insured. It is very conservative to say that this machine does double the work of the old ones, thereby saving the wages of one machinist at $3.00 per day for 300 working days, or $900.00 per year.

2.—An old car-wheel borer was replaced by a new, heavy 42-inch borer with hub-facing attachment, power crane for handling wheels, etc., which cost, installed, $1,710.90. This wheel borer saves the wages of one helper three hours a day and does more than double the work of the old machine, making a total of $2.45 per day, or $735.00 a year, which amounts to 42½ per cent. on the investment.

3.—A new heavy double head car-axle lathe, costing $1,665.00 installed, turns out one-third more work than the old one on account of taking a heavier cut and heavier feed, thereby saving about $250.00 a year, or 15 per cent. on the principal.

4.—It formerly required about four hours for eight men with screw jacks to take a 10-wheel engine weighing 132,000 lbs. off its drivers, at a cost of $5.14, and about one-half that time for four men to do the same work with hydraulic jacks; but using four pneumatic jacks, it is now regularly done by four men in one hour at a cost of 66 cents. However, to be strictly up-to-date an electric crane should be used and the time reduced to ten minutes.

5. A pneumatic ram was recently made at a cost of $168.55 for breaking staybolts to remove worn-out fire boxes, which earns very large interest on the investment. It formerly cost $45.60 to cut out the crown bolts and staybolts of a 10-wheel locomotive with 9-foot fire box, using three men, but with the pneumatic ram it is done by two men for $15.20, thereby saving $30.40 on each fire box. If only one fire box was removed each year this tool would earn 18 per cent. on the investment, but as this shop applies 30 new fire boxes a year the saving amounts to $912.00, or 541 per cent. per annum on the amount invested.

6.—In a certain shop which makes general repairs to about 160 locomotives a year the average length of time required to put each engine through the shop was reduced from 34 days in 1898 to 30 days in 1900. This represents a saving of 640 days for one locomotive, which, at a rental value of $10.00 a day, gives $6,400.00. As this was done with the addition of only a few new machines in a shop full of old and worn-out tools, many of which had been in service from 25 to 35 years, you can readily understand how much greater saving could be effected had the shop been fully equipped with up-to-date machinery.

* * *

The hottest place (on earth) is said to be at Mammoth Tank, Colorado desert, where the temperature has risen to at least 128 degrees.

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OCTOBER, 1902.

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The index to volume eight of MACHINERY is now ready for distribution and will be sent to any reader upon receipt of postal card request.

* * *

With the establishment of the Engineering Edition of MACHINERY there is more room available in the dollar, or Shop Edition, for letters and short articles upon shop methods and devices and kindred subjects. Much of the general matter, such as has occasionally been published in MACHINERY, will now be transferred to the Engineering Edition, which will give additional space in the Shop Edition for articles dealing directly with shop practice. We intend to have these articles in greater variety than ever before, and readers of MACHINERY can materially assist in this by giving us the results of their experience and observation in the form of brief contributions, accompanied, if possible, by sketches or photographs. For the benefit of those who have not contributed, we will add that all sketches are redrawn in the process of engraving, no matter how good or how poor they may be, and that manuscripts are re-written in this office if necessary. While manuscripts and sketches should always be prepared as carefully as possible, a contribution will not be rejected simply because it needs considerable revision. It is the *idea* that we want, and if the idea is a good one it will always have careful consideration. All accepted contributions are paid for upon publication. There is probably not a machine shop in the land but that might supply something of value to many of our readers. All live mechanics are interested in something pertaining to shop work, and it is this something that we want to hear about.

* * *

BLACK DIAMONDS FOR USE IN THE ARTS.

Some months ago the writer visited a well-known shop in Brooklyn (National Meter Works) and was shown some interesting examples of the use of black diamonds or carbons for lathe and other machine tools. Some of the working parts of water meters built by this company are made of hard rubber, which has to be machined after being molded. It will probably surprise some mechanics who have never worked this stuff to learn that it is one of the most difficult substances known to machine with steel tools. In fact it is impossible to work it accurately with ordinary steel tools, or any steel for that matter. Some peculiar property of hard rubber, developed by the combination of ingredients necessary for vulcanizing, causes it to blunt the edge of the finest and best steel so quickly that it is rarely possible to go over the surface of a small piece even and have it pass the inspectors' limit gages, the wear of the tool being so great. Consequently it is necessary to use diamond tools for turning hard rubber and they are generally used for this purpose.

In these shops, however, the use of carbon tools has been extended to the regular machine shop departments, making them the finishing tools for turret lathes, for boring gas engine cylinders, and for many other purposes to which ordinary steel is usually applied. The results in the matter of accuracy are very gratifying and if it were not for two or three drawbacks the black diamond tool would undoubtedly become a common lathe tool accessory in many machine shops once its advantages were recognized.

One difficulty is that of holding an irregular mass of carbon so as to present the cutting edge advantageously and still hold it firmly enough to prevent its being dragged out by the pressure of the cut, and lost; but this is not very serious, since the proper function of a diamond tool is finishing and not removing heavy stock. There are a number of methods employed for mounting carbons in holders, the particular one to be used depending somewhat on the size and shape of the carbon and the use to which it is to be applied. Another and more serious trouble is grinding the correct shape of cutting edge for metals. This takes considerable time; again the grinding of carbons is said to be a trade secret not known to many of the regular cutters who work on white diamonds. The most serious drawback to the use of diamond tools, however, is their great cost. It is so great that it renders their use practically prohibitory except where the nature of the substance makes them positively necessary. This condition vitally affects the prosperity of a number of industries. Diamond dies are largely used for drawing the finer wire sizes and the diamond drill is extensively used in prospecting when it is desirable to secure a solid section of rock from depths.

The only place in the world in which black diamonds are found in sizes large enough to be of commercial value is in the state of Bahia, Brazil. A recent report made by Mr. H. W. Furniss, U. S. Consul at Bahia, Brazil, makes public considerable interesting information regarding the mining of diamonds and the reasons for the excessively high prices that prevail. Mr. Furniss says that contrary to what is generally believed to be the case, there is no combination of interests or syndicate that controls the output of carbon; the limited supply and consequent high prices may be attributed to the lack of proper machinery for mining.

Diamonds were first discovered in Bahia, Brazil, in 1821, but it was not until 1844 that they were mined to any extent. All diamond and carbon-bearing lands belong to the State, but it is possible for a person of any nationality to take out mining claims by complying with the State regulations, which do not appear to be rigorous. The climate, however, is very bad, fevers and other diseases being prevalent. The miners do not work systematically and the character of the tools used is very crude. Diving machines are used to a limited extent to get the precious stones from the river bottoms, and naked divers also work these beds. The geological formation of the district is volcanic. The diamonds are found in sandstone pebbles containing a very hard matrix. These pebbles are mixed throughout the granite and when exposed to the weather they disintegrate and expose the diamonds and carbon hidden within. The quantity of the granite containing diamonds is enormous and the production could be multiplied many times provided proper machinery and modern methods of mining and handling rock were employed.

The present output of carbon from the diamond district averages about 2,500 carats per month of all classes—porous, crystalline and good. The most valuable sizes are those weighing from one to two carats. Larger sizes have to be broken up to be used, which causes loss; and the smaller sizes are not in great demand. The largest black diamond ever found was discovered in the Lençoes district (where the best ones come from) in 1895. It weighed 3,150 carats and sold to the exporter for $24,500. The next largest in size was found in the same district in 1901 and weighed 577 carats. This was sold by the miner for $17,380. The average size of carbons is six carats. Almost the entire product of diamonds and carbons is shipped to London and Paris.

DRILLING JIG PLATES.

AN ORIGINAL METHOD FOR ACCURATELY SPACING DRILLED HOLES.

J. R. Gordon.

The method of drilling the holes in plates of jigs here described is to the best of my knowledge entirely new, and as I am associated with several toolmakers, of wide experience and acquaintance, who are of the opinion that the method is well worth introduction into general use, I offer it to the consideration of the readers of Machinery.

Having a large number of jigs to make and desiring to have the positions of the drill bushings accurate to within .001 of an inch, I removed the work table from an ordinary sensitive drill press of the usual pattern, and substituted therefor one of larger dimensions, to accommodate the size of the jig plates.

This table was first planed on the face and edges, and the stem, by which it is held in the bracket on the column of the press, was turned to fit snugly the hole in the bracket.

After planing and turning the table a series of holes was drilled, as shown in Fig. 2, and they were tapped to receive a No. 14-20 screw. Two parallel pieces *C* and *D*, Fig. 2, having straight edges and a thickness of ⅜ of an inch, were made and are to be clamped to the table in such position as may be desired or the work determine, the series of holes permitting any adjustment within the range of the table.

In order to make more room between the spindle and the column of the drill press the spindle head was blocked out, the block having a projecting lug as shown at *A*, Fig. 1, to

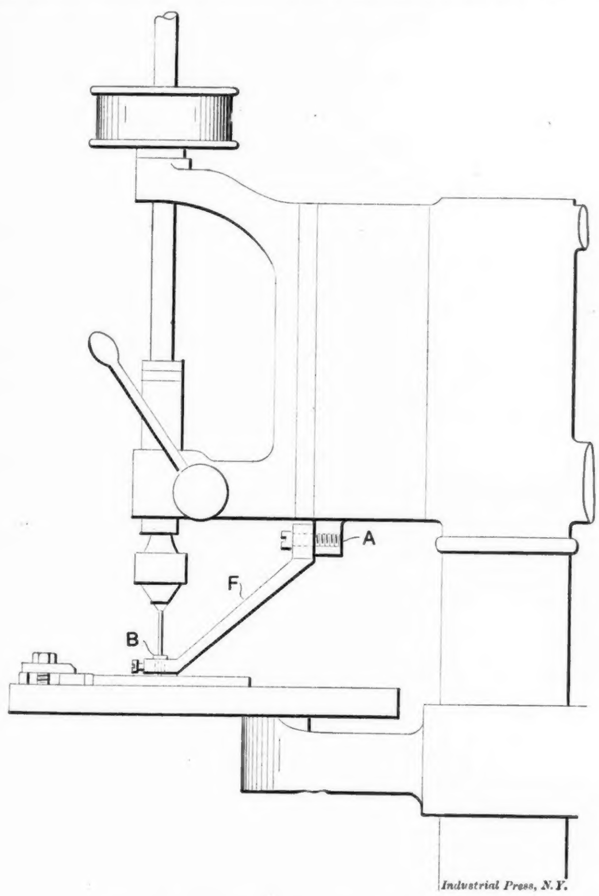


Fig. 1. Drill Press Arranged for Drilling Jig Plates.

which a bracket, *F*, was fastened to carry the bushing, *B*. This bushing is fastened by a screw and can readily be removed to insert others having various sizes of holes, if found desirable.

These preparations were all that were necessary with the exception of the gages that will be described in the operation of the method for spacing, which is as follows:

The plate to be drilled had a number of holes spaced as shown in Fig. 2, and before drilling them I marked them out as Nos. 1, 2, 3, etc., No. 1, as will be seen, being the upper right-hand hole. Its location with reference to either end or sides of the plate did not require to be very exact; but other plates may need to have the holes placed at some definite distance from the edges or ends so I will describe this one as having the distance 6 inches from the edge, *G*, and 8 inches from the end, *H*.

With these distances given I then make two gages, using vernier or micrometer calipers for my standard, and make them 6⅛ and 8⅛ inches long respectively. I then remove the bushing, *B*, Fig. 1, and in its place insert a plug having a diameter of ¼ inch.

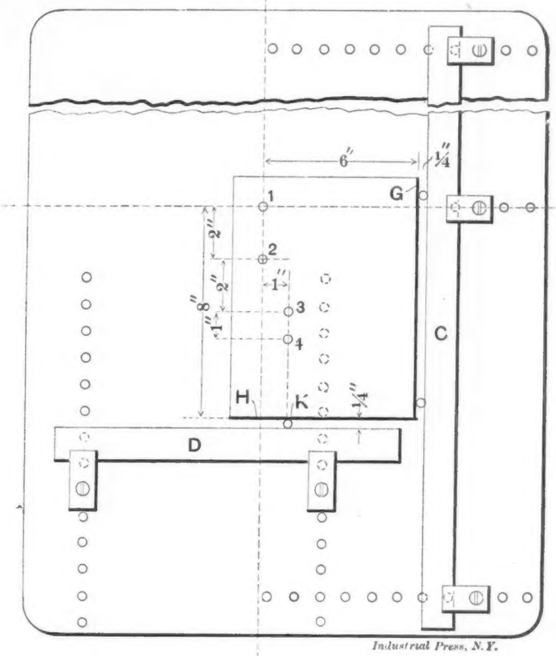


Fig. 2. Plate in Position for Drilling first Hole.

Resting the 6⅛ gage on the table, and with one end touching the plug, the parallel piece, *C*, Fig. 2, is brought to just touch the other end of the gage and is then clasped to the table. This is not much of a trick if one end of the parallel is left free and the other end is clamped tight enough to permit the free end to move somewhat stiffly. After locating and clamping the parallel, *C*, the other parallel is clamped in position, but it must be placed square with the first parallel. This is more of a trick than the first one, but is not at all difficult if one man can be employed to clamp the piece while another holds the square and gage.

The reason for making the gages 6⅛ and 8⅛ inches long instead of 5⅞ and 7⅞ inches respectively is that it is not desirable to have the edges of the plate touch against the parallels, as chips could get between the two and destroy the accuracy of the measurements; so I allow the gage to be ¼ inch longer than the distance required and fill the space in with ¼ inch diameter gages as shown in Fig. 2.

For gages over 1 inch in length I use flat brass rods or strips about ⅜-inch wide and ⅛-inch thick and cut them a little longer than the finished length. One end is finished square and the other end is rounded as shown in Fig. 5. In making the gage, if too much metal is removed it is an easy matter to pene the stock out to make up any reasonable error. The length of the gage is stamped on it, and when the operation is completed it is put away for future use.

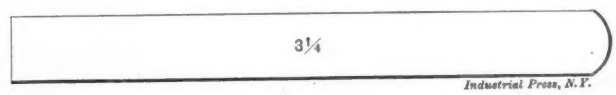


Fig. 5. Gage.

Having located the parallels, the plug is removed from the bracket and the bushing replaced. The drill should, of course, fit as snugly to the hole in the bushing as it can and run without cutting. The bushing should support the drill to within a distance equal to the diameter of the drill from the plate to be drilled and care should be taken not to drill through the plate until all the holes have been started.

After drilling the first hole to place the plate for the second

hole, distant 2 inches from the first, it is moved along the parallel, *C*, and a gage 2¼ inches long placed as shown in Fig. 3, and when so placed is ready for drilling.

The third hole requires three new gages, since it is 1 inch off the line of the other two holes, as shown in Fig. 4.

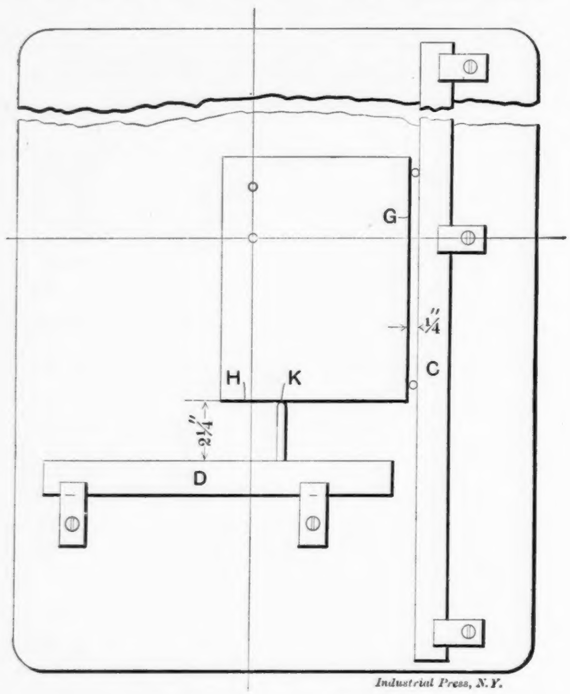


Fig. 3. Plate in Position for Drilling second Hole.

For holes which are to be finished 3-16 inch to ¾ inch in diameter I first use a small drill, size No. 52 to No. 30. After the holes are all drilled to this size I then enlarge them, by the use of a series of four lip counterbores, to the required size. Where extreme accuracy is required, in the place of the counterbore, a small boring bar may be substituted and the holes bored to the size desired.

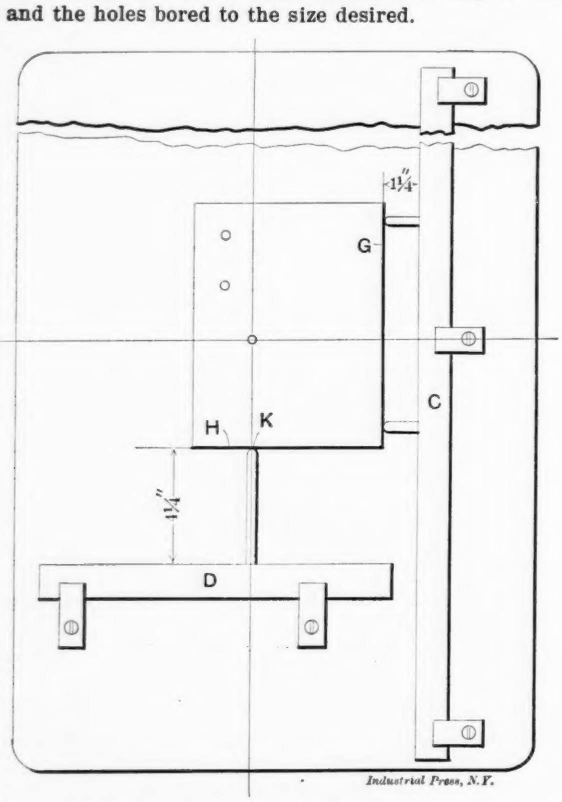


Fig. 4. Plate in Position for Drilling third Hole.

One disadvantage of using a boring tool is that it requires a hole in the table equal to the largest hole to be bored out or that the plate shall be kept clear of the table by blocking up with parallel strips under it.

Fig. 6 shows a form of boring tool which I have found very convenient for use on this kind of work.

It consists of the shank, *A*, which is fitted to the taper hole in the spindle and a split holder, *B*, which is pivoted to the shank at *C*, and is locked to it at *D*; the screw at *D* serving to clamp the boring tool, *E*, at one end, while *F* clamps it at the other end. Adjustment is obtained by swinging the holder, the radial slot, *G*, allowing it to have quite a range and the stop screw, *H*, permitting fine adjustment. Split bushings in the holder will allow the use of boring tools of smaller diameter if desired.

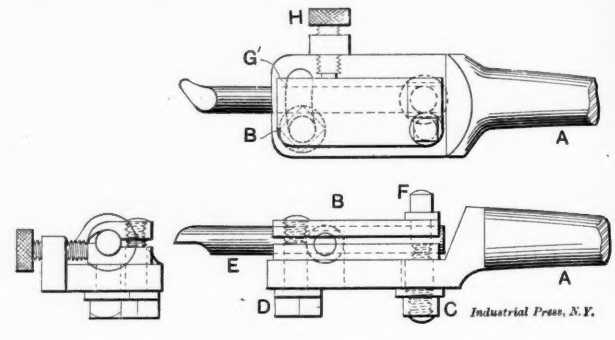


Fig. 6. Boring Tool.

This method of locating holes is not limited to the drill press but may be employed to advantage on the faceplate of a lathe. In this case the work, as soon as located by the gages, is clamped to the faceplate.

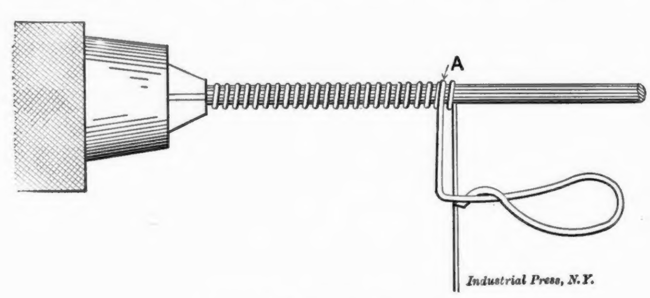
While this method was originated for drilling holes in jig plates, it may be used with equal success for drilling small interchangeable pieces. It is not necessary that the edges, *G* and *H*, be planed at right angles, as the same results will be obtained if the surface, *G*, is planed true and a finished spot provided at *K*, from which point all measurements to the parallel, *D*, are made.

* * *

WINDING SMALL SPRINGS.

P. A. Whitney sends us a little trap for winding small springs up to, say, No. 12 English standard gage, which is shown in the cut. It is accompanied by a spring, wound by this means, which is very regular and satisfactory.

The method for using the device is very simple. A drill rod, about 3 feet long, which is a little smaller in diameter than is wanted for the inside of the spring, is put in a drill chuck and a piece of wire of the size of the space between the



Device for Winding Springs.

coils of the spring is put in beside it and two coils are wound and cut off as shown at *A*. One end is twisted to form a loop for convenience of handling. Now place the spring wire in the chuck, with the rod, and after winding two coils by hand, screw the larger wire onto, or into, the coils thus wound. Then grasping the guide and the free end of the wire in the right hand, start up the lathe with the left. The free end of the drill rod should be grasped in the left hand to prevent its whipping around.

* * *

To indicate when the moving parts of the machinery have become excessively heated, a German inventor has devised a paint composed of an amalgam of the iodides of mercury and copper, which the inventor claims will change color when heated. Bearings to which it is applied are red under normal conditions, but when a temperature of 140 degs. Fahrenheit has been reached the paint becomes black.—*Electricity.*

LETTERS UPON PRACTICAL SUBJECTS.

SOME OF THE TROUBLES OF THE MACHINIST-ENGINEER.

Editor MACHINERY:

I have often noticed in the past, advertisements worded something like the following:

WANTED—An engineer. Must be used to ——— engine, and be a machinist able to do his own repairs, and repairs for the factory machines. Will pay $12 per week.

Whenever I come across such an advertisement as this (and I am sure that your readers have often done so) I wonder what kind of a *rara avis* the man who inserted that "ad" expected to get from the ranks of the unemployed. Now I have seen some mighty handy fellows in the machinists' ranks, but I speak advisedly, I think, when I say that I never saw a man who could fill both positions as they should be filled.

Let us see what is liable to be one day's work for the average engineer. He comes in before anyone else is thinking of starting to work, and putting on his overclothes begins to get up steam. In the meantime something about the engine must be fixed before it can be started, and by the time he has done that it is time to begin to oil and warm up the engine. Soon after starting, a water glass bursts and that must be replaced. Then the Boss wants his lawn mower fixed, or the kerosene stove is out or order. Then he is called to the office to fix an electric bell; and then to repair a bursted pipe or a damper regulator, and in the meantime receive a visit from the boiler inspector making internal inspection. Perhaps also he has to meet courteously two or three oil men and steam packing agents. Some time during the day he has to clean out his spare boiler, find out for the Boss how much power a certain room is using, and because it is thought he is using more coal than he has previously, it will be necessary to take some indicator cards. The Boss thinking that the present will be a good time to stock up with coal comes in and wants to know how much coal the bin will hold, and so he has to measure the bin to find that out. Fortunate is he if he keeps a journal and can refer to that when some of these questions come up. And thus it goes throughout the day. If he happens to get a few minutes to sit down and cool off, during which time he possibly studies the slide rule, or the laws of combustion, etc., some old woman or other (as happened to me) will come in and say: "Then all you have to do is to sit here and see that thing go!" (I don't quite know what she meant, as I have machinery going in three rooms and had already shoveled two tons of coal), but I told her "Yes, that was all."

Now, Mr. Editor, I have had about thirty years' experience as an engineer and some of it has "stuck," but I think the man who writes an "ad." like the above knows little of what an engineer's duty is. It has always seemed to me that an engineer must be born to love his profession, for profession it is and one to be proud of. As for myself I prefer it to anything going.

In connection with this I will tell of an incident that happened in a neighboring city. A certain firm had contracted for an engine of the cross-compound non-condensing type. In due course of time the engine arrived and also a machinist to set it up. It was duly erected (and well done too). When ready it was started up by the man who had erected it, and after it had run awhile he proceeded to take some indicator cards from it. He took some from the high-pressure cylinder and sat down on a box and began to pull his hair seeming strangely excited. The chief engineer of the plant noticing his apparent trouble interrogated him: "What's the matter?" quoth the chief. "Back pressure?" "Yes," answered our friend, "there seems to be back pressure on this high-pressure cylinder." "How much?" "About one-half inch." "Well," answered the chief, "it surely must be some 'inherent' fault of the engine, for the piping is all right." The erector who did not seem to take in the full meaning of the chief's "inherent" was sadly puzzled and informed the chief that he should write to the firm about it. I have often wondered what reception he got when he returned after complaining of back pressure on the high-pressure cylinder of a cross-compound engine.

OLD MAN.

CHUCKING PIECES.

Editor MACHINERY:

I am somewhat surprised in going into different shops to find how comparatively few use what can be called "chucking" or holding pieces, on castings which are to be finished in the lathe. While there are times when this can also be done to advantage on shaper work the application is much more limited than in lathe work.

A chucking piece is such a simple expedient and was so common in the shop where "yours truly" learned his trade that he never dreamed of its being new or novel in any part of the country, but this is the way with many other things also.

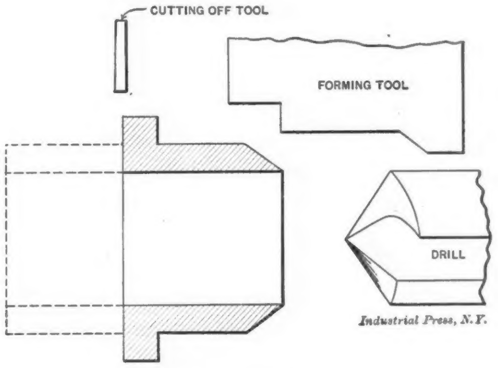
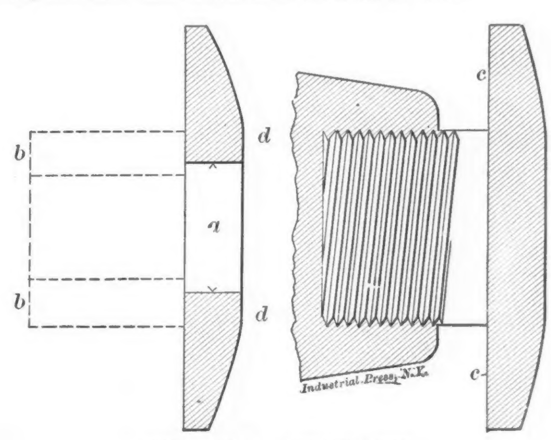


Fig. 1. Chucking Pieces.

You ask a shopman if he has anything new to show you, and he almost invariably answers no, but if you ask how he does this or that piece of work you are likely to find a new method or one that differs from your own practice. It is old to them, and they never think that it may interest you. But to return to chucking pieces.

Two examples will serve to show the application to those who are not already familiar with it. Fig. 1 shows a thimble, of brass in this case, with the chucking piece in dotted line at the back. Without this it would be necessary to chuck the piece twice, with the attendant trouble of getting it true the second time and the danger of marring or springing unless it was held in a split chuck. Of course a mandrel or arbor could be used, but this has troubles of its own as well.



Figs. 2 and 3. Chucking Pieces.

By adding the chucking piece to the pattern you have a place to grip in the chuck and the whole operation can be done without removing from the chuck, thus insuring the whole thing being concentric or true, and saving considerable time. In a turret or Fox lathe this is easily done, and the tools shown give a suggestion in this line.

By threading the chucking piece in a turret lathe and holding it in a screw chuck it is handier working than holding in a regular jaw chuck, and the cost of facing and threading the piece is very little. All the metal contained in this chucking piece goes back to the foundry as chips or scraps, so there is practically no loss on this account.

Fig. 2 shows a disk for a ball joint which was first made by catching in a chuck and tapping the hole *a*, at the same

time facing *d* square with it. It was then put on a screw chuck and the flat side faced off, then reversed and the ball joint finished and the outer edge turned to size.

The addition of the chucking piece shown by dotted lines (this was cored straight through, same as disk) made it possible to face and thread the chucking piece in the turret-lathe and hold in a screw chuck, Fig. 3, as shown. The whole thing could then be done in one operation and cut off complete. While the work might have been held in a jaw chuck, the screw chuck is better in many ways as it gives more room to work around and there is no danger of the work slipping. A Stillson or some similar wrench takes out the piece cut off, with little trouble.

Every shop manufacturing in quantities has many places where some modification of this method can be employed to advantage. R. E. MARKS.

A TAPPING RIG—DIVIDING DEVICE FOR PLANER.

Editor MACHINERY:

I have been reminded to-day of a rig for tapping the feed screw boss of upright frames, that was made in my young days. It had almost faded from my memory, and lest it should do so entirely I send you a description of it at once in hopes that it may do others as good service as it did our firm. The appliance is shown in Fig. 1.

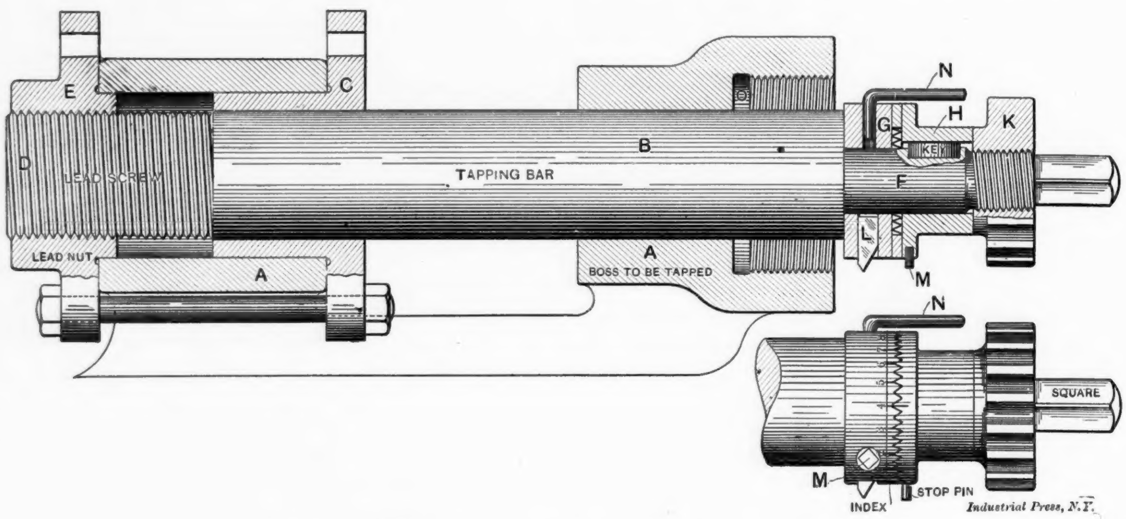


Fig. 1. Tapping Bar for Tapping a Hole Square and in Line with Another.

The drill frames, of which *A A* show the two upper bosses, were previously bored and faced. The tackle for tapping consists of the tapping bar *B* turned to slide on the upper boss *A* and in a bushing *C*, the ends being threaded same pitch as the work to be done, and fitting an internally threaded bushing *E*. Both bushes had projections to correctly locate them, and were clamped against the faced ends of the boss by two bolts as shown. The "business" end of this bar is turned down (shown at *F*) eccentrically, and carries a head *G*, which is free to rotate upon the bar, but can be held in any desired position by means of the teeth formed upon its outside face and the teeth upon the inner face of the bushing *H*. The bushing is prevented from turning by the key shown and it can be firmly clamped against *G* by tightening up the knurled nut *K*. The cutter *L* is square and fits into a square hole and is locked by the square head screw *M*. When it is in the position shown it is at its outer limit, and when exactly opposite, it is at its extreme inner position. The head is rotated by means of the handle *N*.

In practice the head would be turned to bring cutter to such a position that upon turning the bar, by means of a long handle fixed upon the square at the end, a reasonable cut would be taken. Upon reaching the recess *O*, the knurled nut *K* would be unscrewed, disengaging the teeth and allowing the head to be turned right back until the lever *N* butts against the stop pin *M*. The bar would then be withdrawn and the head turned back to the same index position and advanced a notch or two. The cutter head would then be clamped and another cut taken, and so on until sufficient depth of thread is obtained. To gage, the bar is withdrawn altogether.

I can now see where several improvements might be made. Insert a spring between the head *G* and the bushing *H*, in order that the teeth would become free upon unlocking the nut *K*. Cut the thread out of the bushing *E* and introduce a disengaging nut. By lengthening the bar at the end *D* and adding gearing with quick action, or self-acting clutch, the bar could be power-driven. Instead of the nut *K* a quick cam action might be better. However, the principle of the thing is shown, and no doubt many improvements might now be suggested.

Another handy rig is shown in Fig. 2. This is an arrangement for feeding the cross slide screw of a planer in accurate intervals. This screw was ¼ inch pitch and the work necessitated the screw being rotated one and one-half time to feed the tool box ⅜ inch, which was the pitch of the ratchet teeth to be cut upon the work. After spacing by use of this tackle a correctly formed tool was fed in by means of the upright slide, a stop being provided to insure the teeth being cut to exactly the same depth as each other.

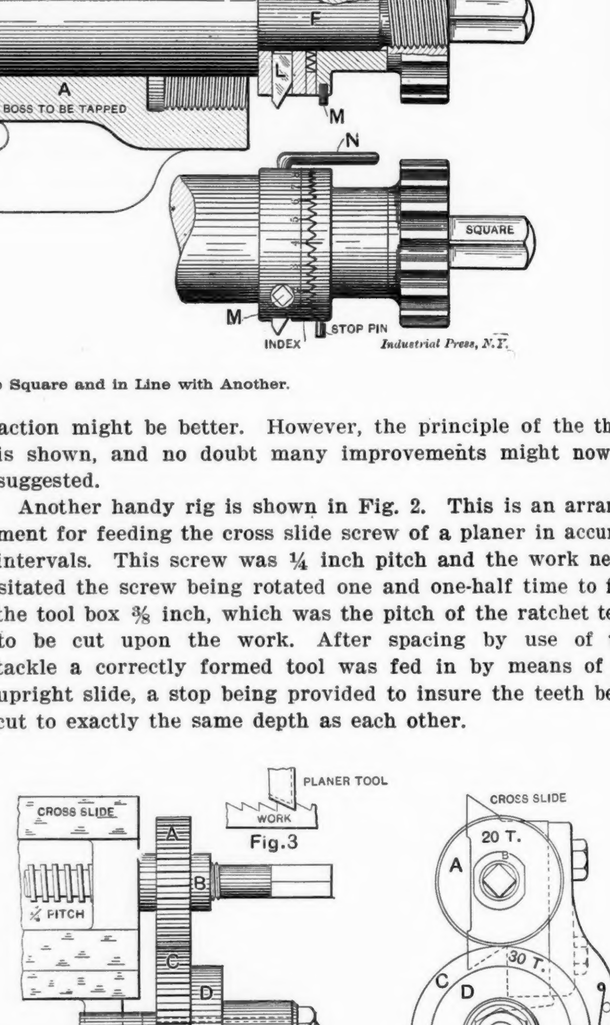


Fig. 2. Device for Feeding Planer Cross-slide for Rack-cutting, etc.

The pinion *A* is locked to the screw by the nut *B*, and meshing into it is a wheel *C*, which wheel has connected to it the stop disk *D*. The lever *E* is pulled forward allowing the stop disk *D* to be rotated by the handle. As soon as the stop *F* on the disk *D* has passed the lever *E*, the lever is allowed to spring back, and thus acts as a stop to prevent the disk being turned more than once round until the lever *E* is again pulled forward. One turn of wheel *C*—which has 30 T. and the piston only 20 teeth—rotates the pinion 1½ times, and hence feeds the tool box 1½ times ¼ inch, or ⅜ inch.

It would be possible to arrange the rig so that wheel in

any ratio could be fixed in place of A and C, in order that any pitch could be cut, but to secure accuracy of division the disk D should always make one complete turn.

Birmingham, Eng. FRANCIS W. SHAW.

"TWENTY YEARS AGO"—PATTERNMAKERS' DOGS.

Editor MACHINERY:

In every issue of MACHINERY and other mechanical publications appear articles and illustrations of handy and simple mechanical methods for doing work which are studied and appreciated by the great majority of mechanics, but along comes some fellow who writes that he saw or used the same thing "twenty years ago." Well, suppose he did; if it is a good thing and he saw it "twenty years ago" is that any reason why others should not know of it?

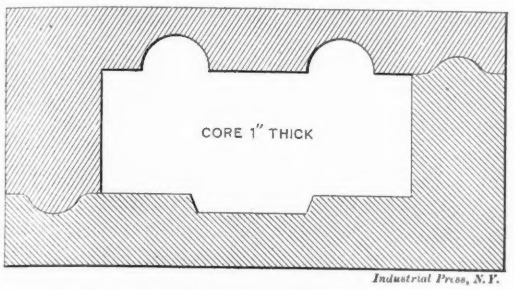


Fig. 1. Simple Method of Making Core Box.

I send herewith sketch of a simple way for making a core box which may be old to some but new to me, and it may be to others. The core box, Fig. 1, was made in fifteen minutes, all done on a band saw.

The writer once had a number of boards to glue together, edge-to-edge, and to clamp them used the ordinary iron "dogs." I had two dozen clamps, but found only 7 fit to use, so I went to the workman next to my bench to borrow a few, but like myself he had only 5 in 3 dozen in order, and so it was with two other men; these iron "dogs" are used almost as much as any other tool in a patternmaker's kit and how few workmen keep them in working order.

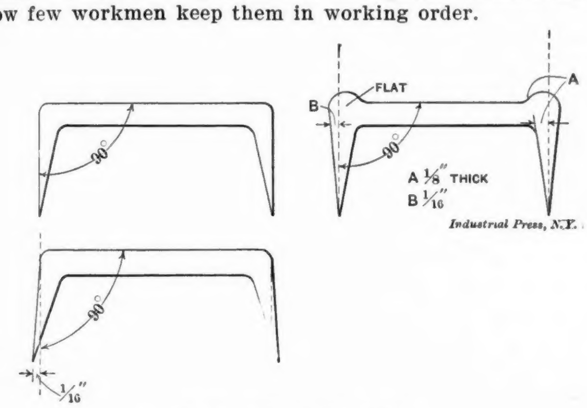


Fig. 2. Patternmakers' Dogs.

The patternmakers started in to discuss the "dog" question and what was the best shape and design for clamping and strength. Each man had his way for making a clamp, but no two men agreed that any particular "dog" was shaped right. I send sketch of a few "dogs" that each man had, and each thought his was just right. I would like to hear from some of your readers what their ideas are on the dog designs.

PATTERNMAKER.

A SCREW MACHINE CHUCK.

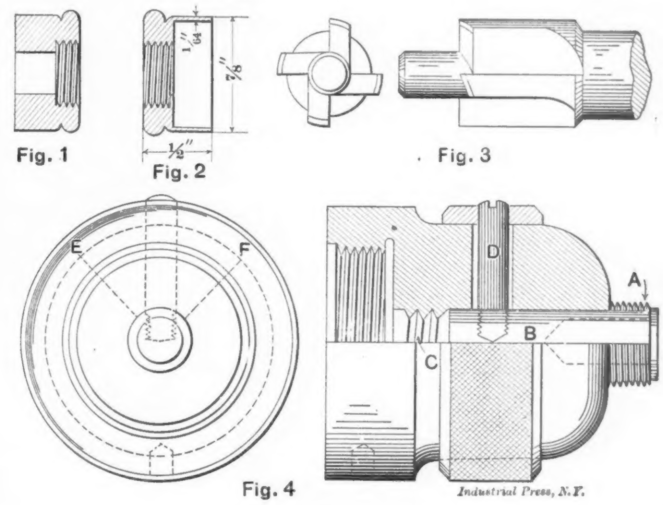
Editor MACHINERY:

A short time ago I had a screw machine job which seemed to present some difficulty but which was easily accomplished by use of the chuck here shown. The main difficulty came in performing the second operation, which left the piece with a wall of metal but 1-64 inch thick. Fig. 1 shows one of the pieces after the first operation has been performed and it is ready for the second operation, for which this device was constructed. Fig. 2 shows one of the pieces as completed by the second operation. This operation was performed by the counterbore, Fig. 3, the piece being held in the chuck shown in Fig. 4.

The end of the chuck was threaded at A to receive the tapped end of the work. Through the body of the chuck ran the plug B, which had a left-hand thread for fitting the chuck at C. A pin D connected the plug to a knurled ring on the outside of the chuck.

The pin D worked in a slot from E to F so that the ring could be turned through one-fifth of a revolution.

The method of performing this second operation was as follows:



Screw Machine Chuck.

The knurled ring was turned until the pin D bore against the side of the slot E, when the work was screwed on the end of the chuck until it bore hard on the end of the plug B. The counterboring was then performed in the usual way. Now to release the work the knurled ring was turned one-fifth of a revolution, or until D bore against the side of the slot F, thus withdrawing the plug B from its bearing against the work which was left free to be easily unscrewed.

Syracuse, N. Y. HORATIO J. TAYLOR.

TROUBLES OF THE DRAFTSMAN.

Editor MACHINERY:

When an improvement and addition is made to a machine already being manufactured, every detail of the job is carefully planned out in the drafting room, even to the tools required for doing the work and the best manner of assembling. After a great deal of thought, many changes, and not a few misgivings on the draftsman's part, it is completed and put into the shop with full instructions for operating it; the work is finished, the assembling is successfully accomplished and the machine operates properly.

The passing machinist often thinks, "What a snap those draftsmen have. They simply tell us to do such and such things and *we* have to do the work. There seems to be plenty of room for each part; the idea is simplicity itself, anybody might have designed it, had he been asked to do so." Now this man probably wishes he were a draftsman; but if he knew the difficulties to overcome and the seemingly insurmountable obstacles that present themselves in the process of design, he might think differently. Suppose we give him an idea of the amount of work involved.

If someone invents an attachment for the machine, it is generally turned over to the chief draftsman in the form of a rough pencil sketch, giving no idea of either size, proportion or detail, and generally with no explanation whatever or, at the most, only a few words. The chief draftsman must then study it carefully until he has formulated in his mind an idea of how it can best be built and also something of the size and proportion of the parts to do the required work. He then takes a drawing of the machine, of one quarter or one-eighth size, and tacks a piece of tracing paper over it. On this he lays out the center lines and a few of the most important parts, designing, as far as possible, the best sizes of gears, pulleys, shafting, etc. If the improvement is to be

put on a machine which has already been manufactured for several years there is very likely to be a scarcity of room; and this will sometimes necessitate the discarding of several different schemes, on each of which he will spend considerable time. When he finally "hits upon" a design which he thinks will do he calls up his best available man and explains the situation as completely as possible. This man proceeds to make an assembly drawing to the largest advisable scale, first drawing all parts of the original machine which will come adjacent to the new part, or to which it will be connected. At this point his trouble begins, for he soon finds it necessary to change the original machine here or there, to make room for this or that part. This he doesn't like to do for several reasons. It makes trouble in filling repair orders, the machine to be fitted with the new part may only be half done, or there may be a quantity of these particular pieces in the stock room. As a result it is generally necessary to make a compromise between two or more evils.

Next he may want to make a part which is not easily molded or machined, and then another compromise is required. And so it goes, deciding to make each part "so and so," not because it is just what he wants, but because it is the best that can be done under the circumstances; often taxing his mind at spare minutes for days, or even weeks, trying to think of some good way to overcome certain difficulties. Sometimes he thinks of a good plan only after the drawings are completed, when, if it is of sufficient importance, it may be necessary to redesign the whole machine. And sometimes he may think of it the minute he sees the completed machine in operation. I have seen instances where the new idea was enough better than the old to warrant throwing the first into the scrap heap.

But I am digressing a little. To go back to where the drawings are finally completed and approved by the superintendent, they are then sent to the pattern shop where it will be necessary to watch the patternmakers carefully, else they will surely get you into trouble. It must now be decided, by ascertaining the stages of the work already in the shop (unless this has been predetermined by existing circumstances) with which lot of machines to make the change, and then inform the head of each department as fully as possible of that part of the change which will affect him. He must be careful to tell him which lot will first have the change and all the original parts which will be left off or changed in any way.

The best time to make the change is on a lot for which the shop orders have not been sent out. The instructions can then go with the orders, making it comparatively easy. Generally, however, this cannot be done as the improvement is wanted on the first machine possible, even at the sacrifice to the scrap heap of some parts already made. In this case it is sometimes necessary to start some parts in the shop before the drawings of others are fairly finished. It is also necessary to call in from the shop all discontinued drawings and patterns, to avoid the possibility of mistakes which may arise from using the wrong ones. This cannot be done until all machines without the improvement are completed, complicating matters still more by making it necessary to remember just what has been done and what not done, out of a long list of changes. If a complete list be made of the things to be done for each change then as each is finished it can be checked off.

It is always best when a drawing is in process of construction to consult with the heads of the shop departments. Their ideas as to the way in which a piece can best be made are worth a good deal, and they are then more willing to make the change when it comes and have probably already made their plans for doing the work.

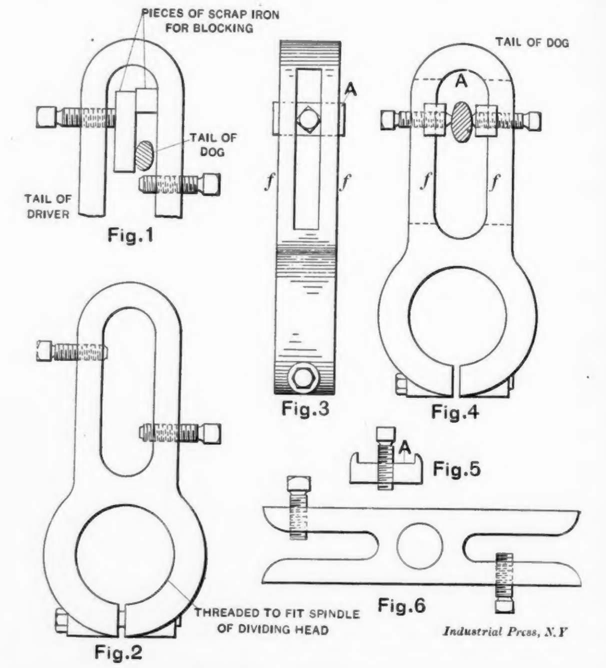
FRED S. ENGLISH.

IMPROVED DRIVER FOR MILLING MACHINES.

Editor MACHINERY:

The milling machine of to-day is, I believe, considered to be the best all-around tool in the modern machine shop and probably is the one that is kept most strictly up-to-date by the manufacturers. I have found, however, that there is one feature on at least two of the best makes that is defective and that is the driver for the dividing head. And this is now constructed it is more a case of luck than design that the set-screw of the driver comes in the proper place to bind the tail of the dog, as is necessary to prevent back-lash when using the dividing head. I have often found it necessary to clamp the tail of the dog in the "toggled-up" shape illustrated in Fig. 1. This of course takes time and makes a very unsatisfactory arrangement.

Having charge of several milling machines, I was free to make such changes and improvements as were found necessary to increase the efficiency of the machines. Fig. 2 shows the style of driver that came with the machines. This driver was quite unsatisfactory for the reason just given and also that the set-screws were not opposite each other. This is often a very desirable feature, as it is mighty handy to be able to loosen one screw and tighten the other slightly on the tail of the dog to shift a piece a little. Figs. 3 and 4 show the improved form of driver that I designed. A pattern



Improved Driver for Milling Machines.

was made for the castings and the slots were cored out. These slots were for the sliding nuts *A A* for the set-screws, the idea being to shift the set-screws along the slot to bear on the tail of the dog wherever it was and have both set-screws in alignment. Fig. 5 shows one of the sliding nuts of which there are of course two made for each driver. The inner edges and sides of the slots in the driver (where marked *f*) were machined on a shaper.

The familiar form of driver shown in Fig. 6 was also fitted with sliding blocks or nuts in the same manner. It will be seen that this design makes a driver universal within its limits and that the tails of all dogs used can be properly clamped regardless of their length or position. If a dog is used having a bent tail it can be clamped without trouble between the two set-screws when these are pointed, without causing any twist on the work.

Chicago, Ill. ROBERT A. LACHMAN.

JIGS.

Editor MACHINERY:

The causes for the use of jigs may be summed up under three heads, the order in which they are stated representing fairly well the frequency though not necessarily the importance of the inference of these causes: First, reduction of cost; second, duplication; third, accuracy. We will take first the question of cost.

As no article can, as a rule, be sold in open competition with similar articles unless its cost is somewhat proportionate to the quality of its competitors, commercial considerations demand that the cost be kept as low as possible, while the quality be kept as high as possible. And jigs are one of the chief agents of this in metal work. When a jig is considered,

the first thing to be settled is whether it can be made to pay, and if so, how much. The answer to this often involves very many other questions but can generally, if not always, be resolved into computations based upon the number of pieces to be made, and the probable cost of labor per piece when made with and without a jig; and the cost of the jig including maintenance. Also the fact that often a much less valuable machine or one less busy can be used with the jig, may be an important consideration. If no other factor than cost of production is involved, and it is found that the total cost of the jigged work will come very near that of the lot of articles when made without a jig, and no further order is in sight, it is pretty safe to abandon the jig idea; for it is apt to partake very much of the nature of an experiment, and the odds should be decidedly favorable to warrant the risk.

The second reason—the duplication of pieces—has a somewhat different foundation, though cost enters here also, as will be seen later. Suppose the part to be made is subject to wear or breakage, as in agricultural and textile machinery, guns, bicycles, etc. We know the strong disinclination anyone has for buying a wheel the makers of which have gone out of business. It is at once recognized that repair parts cannot be bought from stock dealers, but must be made at excessive cost and delay. So we have before us the importance to manufacturers that the buying public shall have confidence in the interchangeability of parts in order that sales may be made at all upon the open market. It is a fact that where this reason holds good, there is also the reason that costs will be lessened, because production of large numbers of parts is taken for granted. And in considering whether or not a jig shall be made this combination of reasons militates strongly for the jig.

There is also another reason for jigs, based on costs and interchangeability—it is that in fitting and assembling, those parts which are exactly alike require the minimum labor in putting in place.

In the third place, accuracy is often attained only by the use of jigs. There are jobs which could not be finished at all within the limits of accuracy demanded if jigs of some sort were not used.

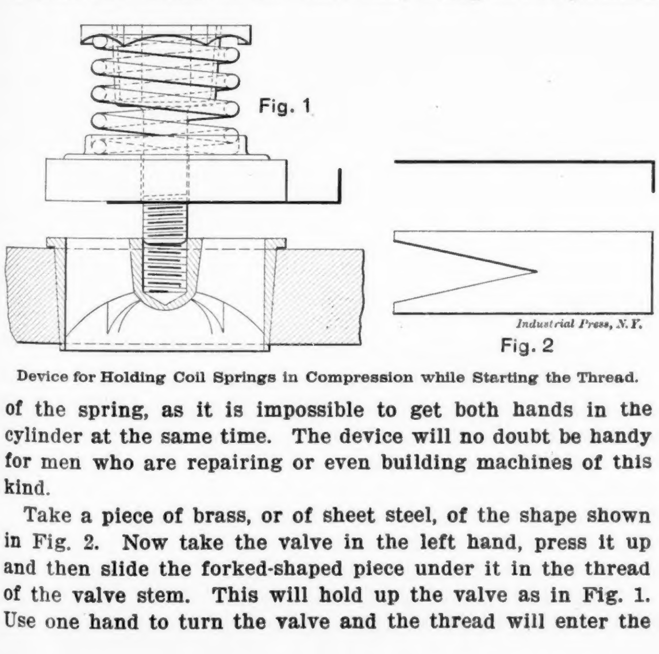
It will therefore be seen that the determination of whether a jig shall be made may rest upon a number of questions which often demand great care and practical experience to solve in the way best meeting the requirements of the case.

F. M. B.

HANDY DEVICE FOR STARTING THE THREAD.

Editor MACHINERY:

I send a drawing of a device for holding up a valve against the pressure of the spring, for convenience when screwing the valve stem in the valve seat. Many water cylinders for steam and power pumps are so constructed that it is difficult to start the thread on the valve seat, owing to the pressure



Device for Holding Coil Springs in Compression while Starting the Thread.

of the spring, as it is impossible to get both hands in the cylinder at the same time. The device will no doubt be handy for men who are repairing or even building machines of this kind.

Take a piece of brass, or of sheet steel, of the shape shown in Fig. 2. Now take the valve in the left hand, press it up and then slide the forked-shaped piece under it in the thread of the valve stem. This will hold up the valve as in Fig. 1. Use one hand to turn the valve and the thread will enter the valve seat. Once the thread is started in good shape the brass fork can be pulled out and the operation continued in the usual way.

It will readily be seen that this device is very convenient in a "tight" squeeze. C. W. PUTNAM.

Holyoke, Mass.

ADJUSTABLE FACEPLATE FOR THREADING ANGLE FLANGES.

Editor MACHINERY:

We have at times a good many angle flanges to machine for our boiler shop (Struthers, Wells & Co.) and no two angles seem to happen at the same time. The annoyance caused by and the time lost in blocking up some makeshift

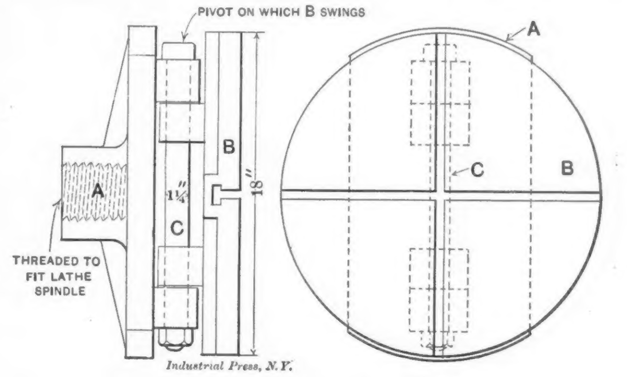


Fig. 1. Adjustable Faceplate for Angle Boring.

contrivance led us to make an adjustable faceplate for the lathe which works on a pivot through which a 1¼-inch bolt fastens it at any desired angle.

The plate *A* with the pivot lugs is cast in one piece, and is threaded to screw onto spindle of lathe. The illustrations,

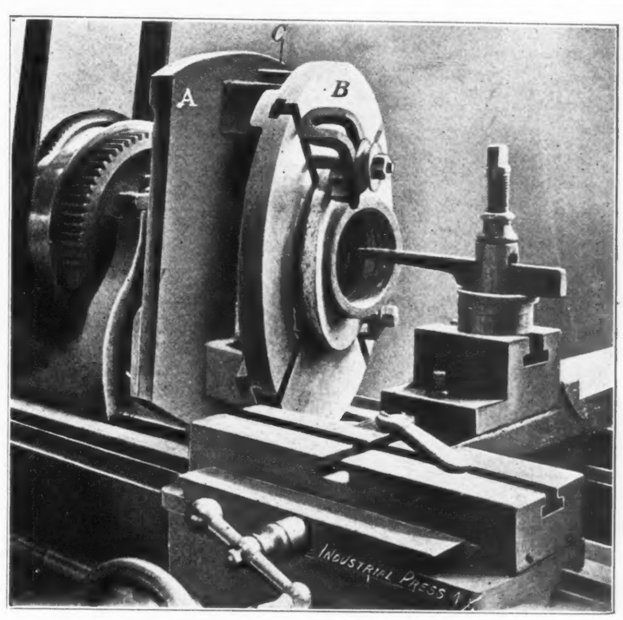


Fig. 2. Adjustable Faceplate for Angle Boring.

Figs. 1 and 2, show quite plainly its construction and adaptation. By placing the flange to be machined against the faceplate *B* and holding it in place with a pipe center, such pieces can be secured ready to operate on in about three minutes.

Warren, Pa. A. A. AVERY.

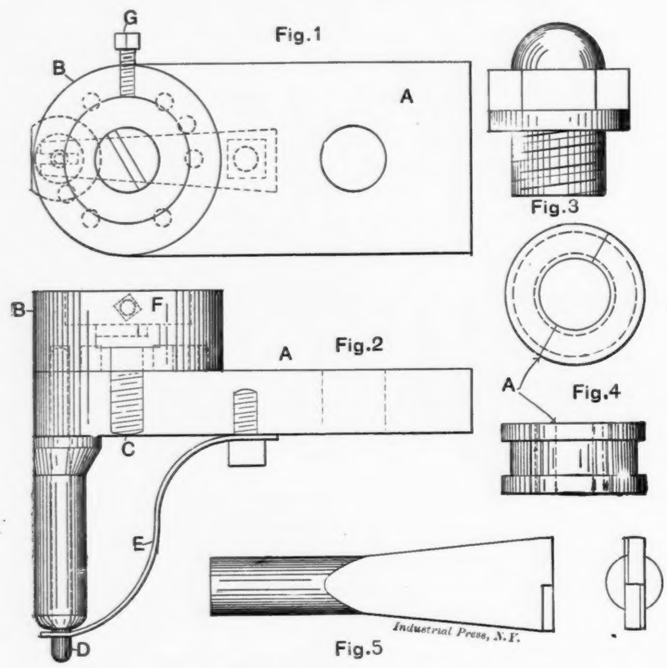
A TURRET ATTACHMENT FOR THE LATHE.

Editor MACHINERY:

A very convenient attachment for holding pieces to be milled is shown in Figs. 1 and 2. This attachment is used on the lathe carriage in place of a tool post. The steel head *B*, which revolves on the central stud *C*, has a number of holes drilled in the bottom to correspond with the desired spacing of the surface to be milled. A spring pin *D* slips into these holes as the head is revolved and holds it in position, while the work is being performed.

Fig. 3 shows a sample of the work for which this attachment is adapted.

The plug here shown is to be milled on six faces. The threaded end is screwed into the steel ring, Fig. 4, and the ring placed in the recess *F* of the turret head. This ring is split at *A* so that it may be firmly clamped to the plug by the set screw *G*, which also fastens it in the turret head.



Turret Attachment for Lathe.

Having clamped the work in the turret, it is fed up to the cutter by means of the cross-feed screw, while the rise and fall attachment of the carriage furnishes the means of vertical adjustment.

A good style of cutter for this work is shown in Fig. 5. It is held by a clutch on the live spindle of the lathe.

Connersville, Ind. E. M. Burgess.

MAKING A CLUTCH PATTERN—PATTERN DOWEL PIN.

Editor Machinery:

The sketches, Figs. 1 and 2, show a simple template for working the jaws of a clutch pattern. The writer has made several clutches and found this to be a simple and true

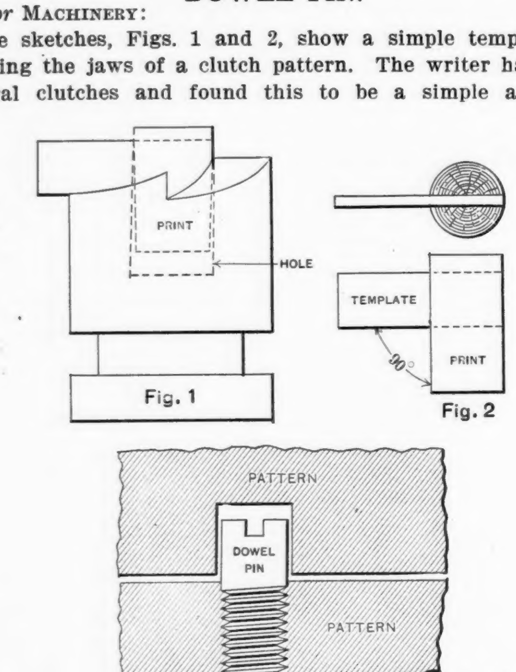


Fig. 3

Making a Clutch Pattern, etc.

method to get the jaws correct. I make the block fast to a faceplate with screws, then turn the outside diameter, bore a hole the size of inside diameter and about 1 inch deeper than bottom of jaw, turn a pin or core print to fit the hole, and on this print put a thin piece to act as a template. The print can be put in the hole and revolved round, showing where to trim the teeth, then removed when trimming is being done. A neat, perfect job can be done in this way.

The writer had a number of small split patterns to make in which it was a difficult job to put dowel pins. After one of the patterns was in the foundry a few days it was returned to have the pins made fast; the dowels were 3-16 inch diameter, ¼ inch long. I saw that wood dowels would not stand the racket, so I made the pins from common wood screws. They not only answer the purpose as dowel pins, but the molder prefers them to wood pins, as they do not swell. I drill a small hole just large enough to turn screw without splitting pattern. I grind the head as shown in Fig. 3, leaving slot.

Chicago, Ill. Patternmaker.

"PISTON HEADS AND PACKING RINGS."

Editor Machinery:

In the July issue Mr. Dunbar writes interestingly on piston heads and packing rings, and in the main, correctly I believe. I fear, however, that he has made one or two statements that may produce a wrong impression, on the younger readers especially, unless supplemented with some explanations that I will venture to give, seeing that no one else has done so to date.

In Figs. 2 and 3 of his article, the writer shows the correct and generally followed method of putting in Dunbar packing rings. He says that it is customary to put them in as shown, to prevent the possibility of the square section ring dropping into the counterbore, should there be a chance of its doing so. Otherwise so far as he is aware there is no reason why they cannot be put in the opposite way if it were desired to do so. Now, in my opinion, it makes considerable difference which way Dunbar packing is put in, and that difference might be sufficient to decide its success or failure. If it is put in opposite to the way shown in Figs. 2 and 3, the steam can blow down through the openings between the ends of the square sections and up through between the ends of the L-sections, provided there is any clearance for the packing rings in the groove and, as Mr. Dunbar says, some clearance of course must always be given. But when put in properly the two rings break joints effectually by being forced against the inner walls of the packing grooves. Of course if the rings are put the other way steam should not blow by the piston since the rings at the opposite end should stop it. I think, however, that most readers will agree that it is not good practice to have the steam blow through one set of rings to be stopped by the other set, at each stroke of the piston. The life of packing under such conditions would be of brief duration.

The foregoing makes it quite evident that with Dunbar packing two rings or sets of rings, are vitally necessary for a tight piston, and I think the same holds true for the ordinary snap ring to a lesser degree. Mr. Dunbar's analysis of the action of packing rings in the grooves throughout a piston stroke, shows in itself that two rings are always required for good results in a steam engine piston. The pressure of the steam keeps a packing ring against the inner wall of its groove during the first half of its stroke at least and its momentum during the second half, if the steam pressure is not sufficient, which, however, it almost always is. The inertia and friction of the ring on the exhaust side of the piston also keeps it tight against the inner wall of its packing groove. So in theory at least the packing rings should have little tendency to side movement in their grooves where there are two, but when there is only one it is of course forced alternately from one side of the groove to the other at every stroke. I believe that two rings—no more—are needed in every steam engine piston. A third ring is of no more use than—(the reader can supply his pet comparison).

It should be noted that the action of the packing rings in a steam engine piston is quite different from that occurring in a pump piston. In a pump piston the rings are alternately forced from one side of the groove to the other irrespective of the number of rings, and this is one reason why they wear out faster in pumps than in engines.

Newark, N. J. F. Emerson.

LONG RANGE CALIPERING.

Editor MACHINERY:

The following problem in "long range calipering" and the way in which it was solved, is but a sample of the jobs which a tool-maker gets out here in the West.

We had a shaft 31 inches in diameter and 47 feet long. A hole, extending through the shaft, was bored 10¼ inches for a distance of 6 feet from each end, after which it widened out to a diameter of 21 inches. The shaft weighed 85,000 pounds, and as this was thought to be excessive a means of measuring the 21-inch portion was desired. I was first called upon to make a caliper that would measure the internal diameter 9 feet from the end of the shaft.

Fig. 1 shows the instrument which I constructed for the purpose. A board 10 feet long was fitted to slide snugly through the 10¼-inch portion of the bore. Upon this board were mounted the wooden caliper legs *A* and *B*, one leg being placed on either side of the board and both pivoting about the pin *C*.

The ends of these legs at *D D* were fitted with metal tips, so arranged that the extreme points were diametrically opposite. At intervals along the length of the legs small strips of glossy rubber were fastened, on the side next to the board, and these relieved any excessive friction between the parts and thus facilitated the operation of the instrument.

To use the caliper, it was pushed through the 6 feet of 10¼-inch bore, at the end, and up to the position where it was desired to make a measurement. The outer ends of the legs were then brought together until the inner points touched the inside of the bore. A mark was made for the position of each leg and the legs brought back to their original position. After the board was removed from the shaft the legs were set, by the mark, to the same position which they occupied when taking the measurement and the distance between the points was measured with an ordinary caliper.

It was, of course, unnecessary to withdraw the board for each measurement as any number of settings could be made, at different distances from the outside, and each set of marks given its respective number so that they could be re-set and measured after the board was withdrawn.

The caliper was used for this job with such success that a modified type, shown in Fig. 2, was constructed for calipering at greater distances into the bore. This caliper was 32 feet long, so that by working from both ends the entire length of the shaft could be measured. As will be seen in the figure, the legs are of the rocker type and are expanded by drawing the rods *E* and *F* outward. It was found that when the caliper was pushed in very far, so that it overhung the support for considerable distance, the measurements were not exact, owing to the sag of the board. To remedy this trouble a supporting stick was hinged near the end of the board, as shown in Fig. 3. This was operated by wires which ran to the outer end of the board. When the caliper was being inserted or withdrawn the stick was closed to the position shown by the dotted lines, and when it had reached the place where the measurement was to be made the upper wire was pulled and the stick brought up vertically until it bore firmly on the top and bottom of the hole. In this position the board was held central with the bore.

This arrangement was quite accurate, as a test measurement, at a range of 28 feet, showed an error of less than 1-64 inch. Within the tube, the caliper was more sensitive to sound than to touch, the chamber seeming to magnify the sound when the points came in contact with the sides of the wall.

E. J. Buchet.

Dubuque, Iowa.

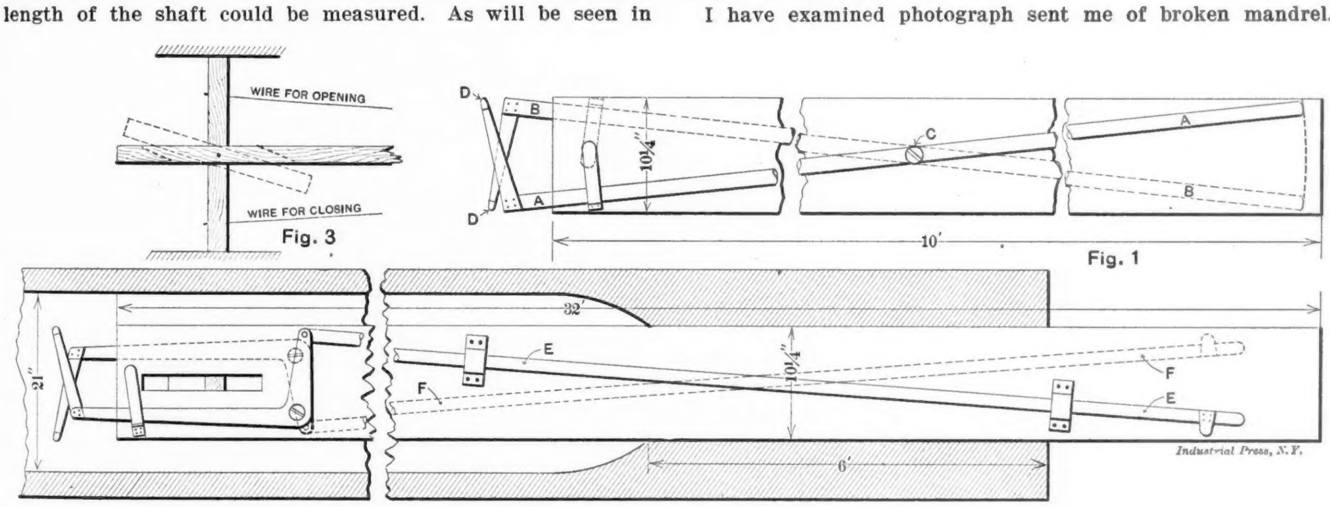


Fig. 2

Long Range Calipers.

WHAT CAUSED THIS BREAK?

Editor MACHINERY:

I inclose a photograph showing an arbor and the result of hardening it.

The lower figure shows the arbor before it was hardened. It was 4¼ inches in diameter at the larger end, 2¼ inches at smaller end, 24 inches long and weighed 57½ pounds. I turned it from a bar of Sanderson's special annealed steel, No. 4½, without forging. On being hardened it broke as shown in the upper figure.

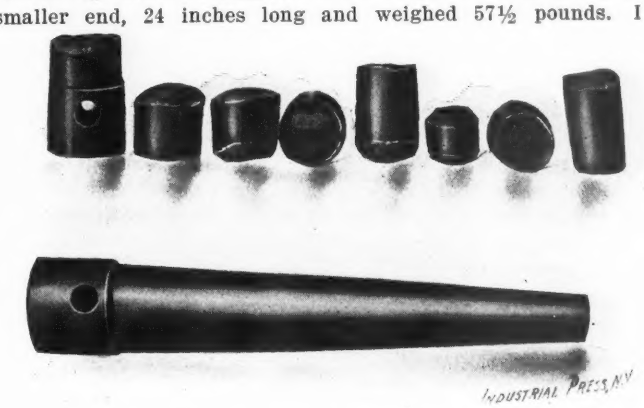


Fig. 1. The Arbor which Broke in Hardening.

Can you tell me what caused the break?

E. J. Buchet.

Dubuque, Iowa.

We referred the above to our correspondent, Mr. E. R. Markham, of Springfield, Mass., from whom we received the following reply.—[Editor.]

Editor MACHINERY:

I have examined photograph sent me of broken mandrel. In order to examine the grain of steel from a photograph it is highly important that a section of the steel be magnified many times when photographed, whereas, the photograph shows the mandrel less than one-eighth actual size. But having had some experience in hardening similar pieces, and having had occasion to look up breaks similar to the one referred to, I will recount some of the causes of steel breaking when hardening.

From the appearance of the fractures it is safe to say that the break was occasioned by internal strains. These strains may have been the result of rolling in the steel mill or of

unequal heating when hardening. To anyone who has made a study of steel and the effects of hardening it is truly wonderful that it is possible to produce a metal capable of standing the immense strain a piece of steel undergoes when hardened.

A piece of steel when heated red hot expands very appreciably. When it is immersed in the hardening bath the opposite process takes place, namely, contraction. The more rapidly the piece is cooled the more rapidly it contracts. Now unless the piece of steel is uniformly heated the process of contraction must be unequal, and unequal contraction is what raises the mischief when steel is hardened.

If the strains were due to the processes to which the steel was subjected in the steel mill, then it is necessary to overcome them before hardening, if possible. Now a piece of steel may be annealed in the bar so it is very soft and works nicely. But in order to overcome the strains in the piece to be hardened, it should be annealed after it is cut to length and the outer surface removed. In the case of a mandrel of the form shown in Fig. 1 the piece should be roughed out to shape, that is, turned tapering, leaving it large enough to finish to grinding size after annealing. The annealing heat should surely be as high as the hardening heat, yet not high enough to injure the steel. The piece should be heated uniformly throughout, the small end should be no hotter than the large end, and the outside of the piece should be of the same temperature as the internal portions. This is as necessary when heating for annealing as when hardening. A precaution which has in many cases worked nicely with me consists in heating the piece of steel to a uniform red heat, after roughing to shape, then standing it on end on the anvil and giving it a blow or several blows, on the upper end with a hammer, or sledge, according to the diameter of the piece. Should it be sprung by this operation it should be straightened while red hot. It may then be heated for annealing. This precaution is not necessary with a piece of steel which has been forged, provided it has been hammered to upset any portion after the drawing operation had been finished. But in the case of a piece of steel cut from the bar and machined to shape without forging, my experience convinces me that the above method insures more satisfactory results, especially if the piece of steel be long.

When the bars are rolled in the steel mill the process is one of elongation from start to finish and the process of hammering on the end has a tendency to in a measure counteract the effects of this.

The process of annealing has the effect of overcoming the tendency to crack from the strains. It is an acknowledged fact among authorities on hardening steel that greater care must be exercised in heating round pieces than if the piece were of some other shape. This is because the circular form is the most rigid and offers the greatest resistance to change. For this reason it is necessary to observe extreme care, when heating for hardening, not only that the heat be the lowest possible to produce the desired result, but that it be uniform throughout.

A great many round pieces are cracked as the result of an uneven heat or one that is a trifle higher than necessary, while if the piece had been of another shape it would have come out all right. The fact that the mandrel is larger at one end than the other adds to the liability of its breaking unless the utmost care is used.

When heating for hardening a round piece should be rolled around frequently in order to get uniform results: because if left to lie in one position in the fire until hot it will be almost sure to have a portion along the entire length of one side that will not harden. This will be the case even if the piece is evenly heated. When the mandrel is heated to the proper temperature, and the heat is uniform throughout, it may be quenched in the bath. It must be dipped as near vertically as possible, dipping with the largest end down. The bath should be quite deep, at least 18 inches deeper than the length of the mandrel. The contents of the bath should be agitated from the sides, or a jet of water should come up from a pipe at the bottom to force the steam away from the heated metal in order that the water, or brine, can get at it.

When the red has disappeared from the steel, in the bath, it should be removed and plunged into a bath of oil and allowed to remain until cool. It should then be held over the fire and heated sufficiently to remove the hardening strains, which, in the case of a piece of steel of the shape shown, will be quite uneven, as the hardening will have penetrated much nearer the center at the small than at the large end.

When dipping in the bath it will be found advisable to use a pair of tongs of the form shown in Fig. 2, so that the cooling liquid may get at the center to harden that.

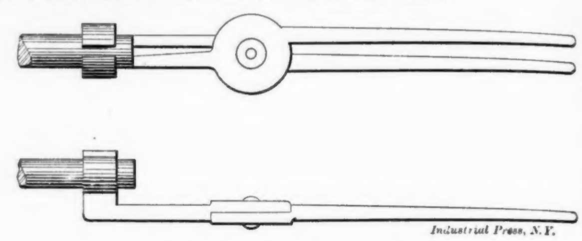


Fig. 2. Tongs for Dipping the Arbor.

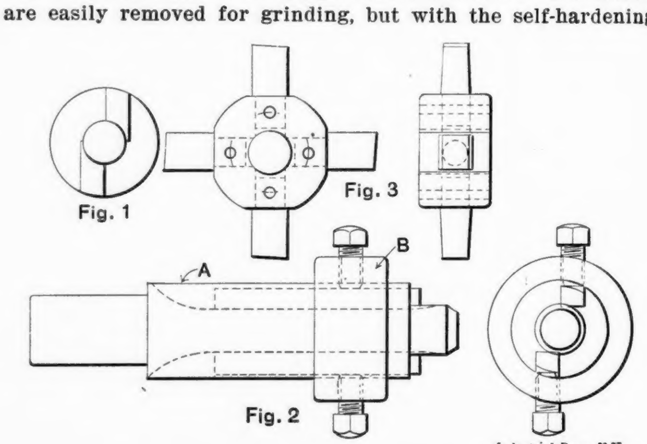
In some shops, where it is found necessary to use steel containing a high percentage of carbon. for cutting tools which must, of necessity, be extremely hard, it is a common error to use this high carbon steel for articles such as the one under consideration, whereas a steel much lower in carbon would answer the purpose as well and be less liable to break in hardening.

NOTES ON COUNTERBORES.

Editor MACHINERY:

The counterbore shown by Corneil Ridderhof in the August number of MACHINERY might be improved if the cutting edges were radial lines instead of tangent to an imaginary circle, the diameter of which is equal to the thickness of the cutting tooth. It will be readily seen, by referring to Fig. 1, that the cutting edges are radial lines and that the cutting teeth are offset enough from the center to form a support directly back of the teat, where the support should be. Counterbores are expensive small tools in almost every shop. Where standard work is done and there is no scale to contend with, the solid counterbore with milled teeth usually does the most and best work.

The writer had occasion to do some facing on rough castings and made a counterbore like the one shown in Fig. 2. The body *A* is slotted with a ¼-inch cutter to a depth slightly below the teat to receive ¼-inch square self-hardening steel blades or cutters. The collar *B* fits the body nicely and contains two screws which are brought to bear against the blades to hold them from end movement. Something over two hundred and fifty holes were swept with this device. The blades are easily removed for grinding, but with the self-hardening



Counterbore and Milling Cutter.

steel this was not often necessary, as it was ground but three times in doing this work. This style of counterbore could be changed for different diameters of holes by having bushings to fit the teat. Larger counterbores could be arranged for by placing liners under the blades or by making the blades wide enough to suit the diameter.

We had some taper slots to mill which were 1 1-16 inches deep, 11-16 inch wide at the top and 9-16 inch at the bottom, and as the job would not permit the use of an expensive

cutter, a cheap cutter was made which answered the purpose very nicely. The cutter is shown in Fig. 3. A machinery steel collar 2½ inches in diameter by 1½ inch face was bored ⅞ inch to fit the milling machine arbor. Four holes were drilled into it and reamed ⅝ inch. The cutting teeth were made of ⅛-inch square tool steel, turned far enough back on one end to drive lightly into the holes reamed in collar. Stubs steel pins 3-16 inch in diameter were driven through the collar into these pieces to act as dowels. After the teeth of the cutters were turned they were taken out and the clearance filed. The cutting end was hardened and the teeth were driven into their places. The teeth did not come back to their original position after driving them in the second time, but an oil stone soon fixed the edges so that they all cut uniformly and the work done was very satisfactory. Shop cost of cutter, $1.20. C. ARBON.

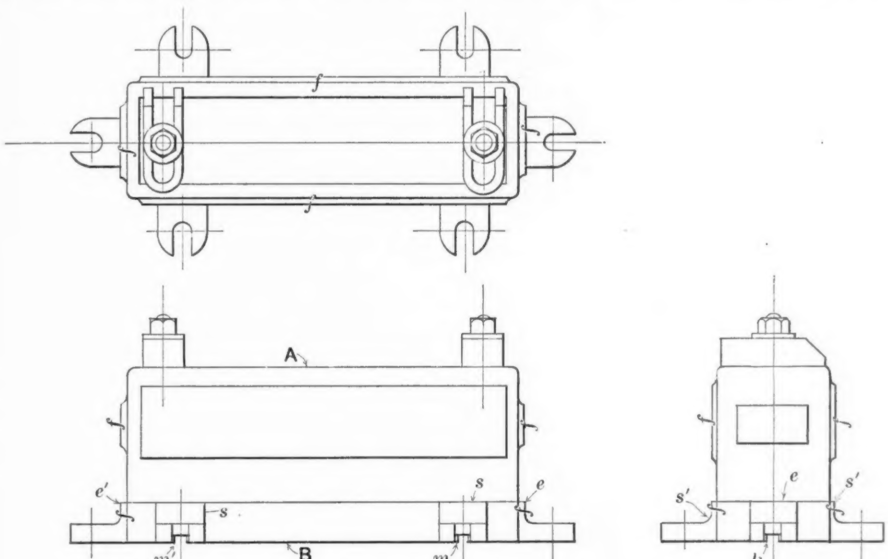
A MILLING FIXTURE.

Editor MACHINERY:

The accompanying drawing and description show a method of milling pieces in duplicate, where several faces are surfaced, which reduces the setting of the machine and handling of the work to a minimum.

Let *A* represent a piece to be surfaced on spots shown on sides and ends, these surfaces to bear definite relations to one another. It is quite possible to put spotting pieces on top or bottom and finish these first, fasten the work to the platen and finish a side and then by parallels and squaring plates finish the other surfaces from the first. But this means a good many measurements, bolts, straps and settings of the machine, the mass of which may be avoided by the fixture shown.

It consists of a casting *B* to which the work is fastened in any convenient way after being located by the spots $e\ e^1$, $s\ s$ and $s^1\ s^1$, which are finished to the dimensions of the finished work, and serve to show the necessary position of the work in order to clean. The fixture has on its lower side a key slot k corresponding to the slot in the machine platen and spaced equally between the opposite spots $s\ s$ and $s^1\ s^1$ on the side.



Fixture for Duplicate Milling.

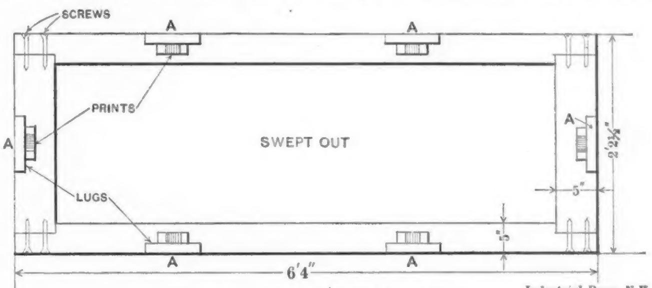
In setting up the machine, the fixture is located by the key, and the cross-feed screw is used to bring spots $s\ s$ or $s^1\ s^1$ to the line of cut of a face mill on the spindle nose. As the slot k is located centrally between the sides to be milled, the same setting of the machine answers for both sides, it being necessary only to turn the fixture around. The ends are gotten in the same way and without altering the setting of the machine, for the slots $m\ m^1$ near the ends of the fixture are the same distance from surfaces $e\ e^1$ as is slot k from surfaces $s\ s$ and $s^1\ s^1$. Therefore, the operator has simply to see that the key enters the slot fairly.

Ears may be provided for receiving the bolts which, when loosened, may simply be moved to suit the new position of the fixture as it is swung around. In practice one side may be milled, then an end, a side, and an end; one rotation completing the piece. On many jobs the key and slots would not be accurate enough, in which case a sole plate upon which the fixture might be located by dowels could be brought into service. The principle, however, would remain the same. B.

HOW FOREMEN DIFFER.

Editor MACHINERY:

The construction of a pattern is at times a difficult problem, not so much in making the pattern, but in constructing and finishing to meet the wishes of the foreman, when no instructions are given as to how the job should be done. While working in an eastern shop I was given a pattern to make as shown in sketch. The only instructions given me were, "*Only one casting is wanted.*" I cut the lumber to size, dressed it down to size on planer, and did as little hand planing as possible. The frame I did not touch with smooth plane, just put it together as it came from the planer. The corners were put together as shown, all parts were screwed and no glue used. I did no waxing or puttying, and the pattern was O. K., also the casting.



SKELETON FRAME 6'4" X 2'2½" X 1¼" THICK

A few months after I quit this shop and went to work in another in the same town. The first job of pattern work was almost the same as the pattern I write about. One casting was wanted. I constructed it the same as the other, and when finished notified the foreman.

He at once gave me a general "*calling down.*" First, the work should be made smooth with smoothing plane; second, the corners should be one-half checked and glued; third, all screw holes and openings waxed or puttied, and fourth, if I knew my business I would do this without being told. When the foreman was done "*calling me down*" I said I would finish the job and quit. He insisted on my remaining at work, but I could stand no such unreasonable abuse as that. A foreman of this type is a disgrace to any shop. When the proprietor or superintendent of a factory finds he has a foreman in his employ who is always finding fault with his workmen, the sooner he gets rid of him the better it will be for his shop, bank account, and workmen.

After leaving this man's employ I made it my business to tell every good mechanic the sort of a boss he was, and I can assure you he had his troubles getting good workmen. A number of men who are to-day placed over good workmen, as foremen, were intended for the police force by nature. PATTERNMAKER.

A WORD REGARDING CORRESPONDENCE SCHOOLS.

Editor MACHINERY:

Now and then I have seen much written for and against the efficiency of teaching by correspondence, and the schools established for that purpose in particular. Taking it as a whole it appears that both sides are right and it only reminds me afresh that there could hardly exist an educational institution that would not be criticized on some ground or other. I

remember hearing a Cincinnati machine tool builder tell of a young man who was in his employ between terms in college and he asserted that every time this young man came back from college he had to start to learn the trade all over again, having forgotten nearly all he knew.

As the college which this young man attended has a fairly well equipped machine shop, and part of this student's time was spent there, this is somewhat surprising, but the chances are that the fault was more with the student than with the college. One thing I noticed is that many who do not believe in correspondence schools seem to forget that these schools can do the teaching only, the learning being the student's part of the programme and the institution is certainly not responsible for the failure or neglect of the "party of the second part."

That the agents of these correspondence schools often assure stupid men of their ability to become machinists, draftsmen or even mechanical or electrical engineers, in their efforts to secure a commission, I do not deny, for I have seen this done myself; but it is not fair to condemn an institution for the mistakes of a few of its representatives. It is certain that through the work of these agents many a man who never considered himself fit for advancement has been aroused to a realization of what he might be able to do if he only tried and has been assisted onward toward mental and financial betterment.

When it comes to catering to the ignorant for enrollment in correspondence schools the mechanical schools are "not in it." Thinking it might interest some of your readers I give the following extract from the matriculation blank of a college of ophthalmology and otology:

"Sign your name (print it if you cannot write it distinctly) in full. Do not give initials, but write what each initial stands for. Example: Not J. J. Jones, but John Jacob Jones."

To think of such a college attempting to coax into its ranks men who cannot write their own name distinctly is amusing if nothing else. The explanation about not writing J. J. Jones, but John Jacob Jones, would cause many of the kind of men who can scarcely write their own names to write John Jacob Jones no matter what their name might be.

That a school of ophthalmology and otology gets down that low bothers me some, but I certainly hope the mechanical schools will never deem it necessary to swell their ranks (and *rank* they would be) with men who have to print their own name because they cannot write it distinctly. It seems the worse because the instructions quoted are on their printed matter and must come from headquarters so that no poor hardworking agent can be made the scapegoat. Before quitting on this subject, I want to express my disapproval of the practice of correspondence schools of publishing a "key" volume in which all questions asked in the examination papers are answered and which is only too apparently done to save the expense of postage and time required to answer the students' questions, while at the same time it causes him to pick up the book for a solution to the problems rather than to use his brain for that purpose. CORNEIL RIDDERHOF.

Grand Rapids, Mich.

* * *

A ferryboat plying between Long Island City and New York was recently put out of commission for a day or so by a curious accident. A fireman had been ordered to clean a pump in the engine room, that was giving trouble. The cylinder head was removed and the fireman thrust his hand and forearm into the cylinder bore without difficulty, but when he tried to remove it the trouble began. The arm stuck fast and struggle as he might the unhappy man could not loosen it. He finally shouted for help, but when it arrived his arm had swollen so that the combined efforts of the engineer and deckhands could not pull him loose. A surgeon was sent for, not with the idea of amputating the offending arm but to reduce the swelling so that it could be pulled out. His efforts were unavailing and all he could do was to administer a hypodermic injection to reduce the pain. So tightly was the arm wedged that it was not considered safe to break the cylinder with a sledge, and it had to be sawn apart on one side and wedged open. It was six hours before the fireman was released.

ITEMS OF MECHANICAL INTEREST.

LARGE TOOL HOLDERS—ADJUSTABLE JAW WRENCH—SPRING DRIVING BELT A GERMAN SLOTTER—TURRET FOR HEAVY WORK—SLOW-BURNING CONSTRUCTION.

A "horrible example" of power distribution is to be found in a certain shop employing over 1,000 men. The power is furnished from thirteen boilers located at seven different points and fired by ten men, while the engines are of all sorts and descriptions, varying from old hoisting engines to plain slide-valve engines thirty or forty years old. There are better facilities in prospect, however.

A receipt for a pipe joint cement was given by Mr. Light at a recent meeting of the Ohio Gas Light Association, which is claimed to be as effective as red lead putty for either faced or rough flanged pipe joints and which costs only about one-tenth as much. It consists of a mixture of ordinary pine tar and iron oxide (fine borings or turnings well rusted will answer the purpose) mixed to a stiff paste. It does not harden so quickly as red lead putty and is very adhesive under pressure.

EFFICIENCY OF BOILER JOINTS.

The weakest part of a boiler shell is the longitudinal seam. This cannot, of course, be made as strong as the solid plate with any riveted construction, but a good design of joint employing multiple rows of rivets and cover plates, will closely approximate it. The Lukens Iron and Steel Company recently equipped their new power plant with horizontal tubular boilers having quadruple-riveted longitudinal seams. These are calculated to have not less than 94 per cent. of the strength of the solid plate. Samuel Vauclain, superintendent of the Baldwin Locomotive Works, has recently patented a design of boiler joint that has a calculated efficiency of 96 per cent. The weakening of the shell depends on how much of the material is cut away by the rivet holes; the smaller the holes the less it is weakened. This fact may make the use of nickel-steel rivets advisable in boiler construction where a high seam efficiency is necessary. The engineer of tests at the Bethlehem Steel Company has demonstrated that a nickel-steel rivet ¾-inch in diameter is as effective as a 1⅛-inch rivet made of common steel.

TESTS OF THE STRENGTH OF GLUE.

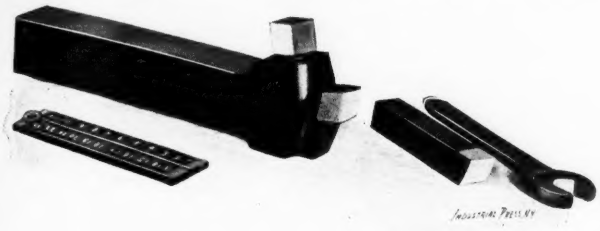
Bearing on the adhesiveness of glue an item has appeared in a contemporary, whose name we have lost, stating that it may be as much as 715 pounds per square inch. In an experiment performed a force of 1,260 pounds, applied gradually, was found necessary to separate two cylinders of dry ash wood, the ends of which presented a surface equal to 1.76 square inch, and which were glued together end to end and allowed 24 hours to set. Even this weight was sustained for two or three minutes before the joint gave way, and it was found, on examining the separated surfaces, that the glue was very thin and had not entirely covered the surface. The cohesive strength of glue appears, therefore, in this experiment to have been rather more than 715 pounds per square inch, while the cohesive strength of the wood in a lateral direction was found to be only 562 pounds, thus showing that if the joint had been between the sides instead of the ends of the pieces of wood, the wood would have given way before the glue. In this case, however, the glue was newly made and the season very dry, while in some former experiments made in the winter season with glue which had been frequently made, with occasional additions of glue and water, the cohesive force indicated was only 350 pounds to 500 pounds per square inch.

MAMMOTH LATHE AND PLANER TOOL HOLDERS.

While the use of inserted cutters, in lathe and planer tools, is a matter of every-day shop practice, probably few machinists are aware of the size of tools of this type that are practical and profitable.

The Western Mfg. Co., of Springfield, Ohio, sends us the photographs shown on the next page of large lathe and planer tools which they have furnished to many of the leading

machine shops. The lathe tool holder is 3 inches square by 20 inches long and weighs 70 pounds. The planer tool holder is 3 inches square by 30 inches long and weighs 125 pounds.



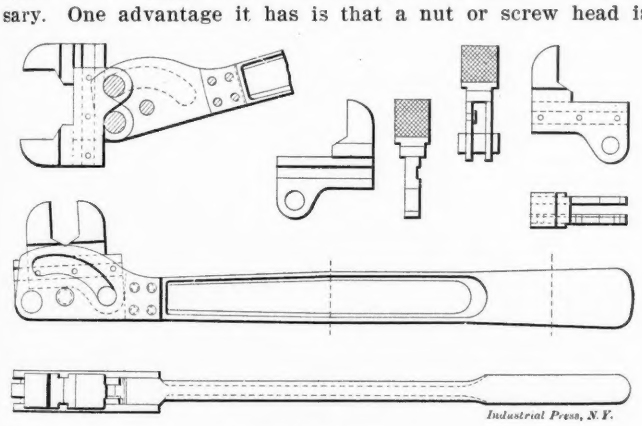
Lathe Tool Holder.

Planer Tool Holder.

Both holders carry self-hardening steel cutters 1½ inch square. These are without doubt the largest tools of the kind ever manufactured.

WRENCH HAVING ADJUSTABLE JAW.

Many inventors have attempted to devise a sliding jaw adjustable wrench to supplant the ubiquitous monkey wrench, but their efforts have generally met with indifferent success. It is true that there are pipe wrenches of this type that are fairly successful, but they belong to a class of tools that apparently must be somewhat cumbersome to perform the work required of them. A sliding jaw wrench for bolts, other than the monkey wrench, that will compete successfully with the latter, is yet to be devised. A German effort in that direction is illustrated in the cut. The principle on which it works is so clearly shown that a long explanation is unnecessary. One advantage it has is that a nut or screw head is

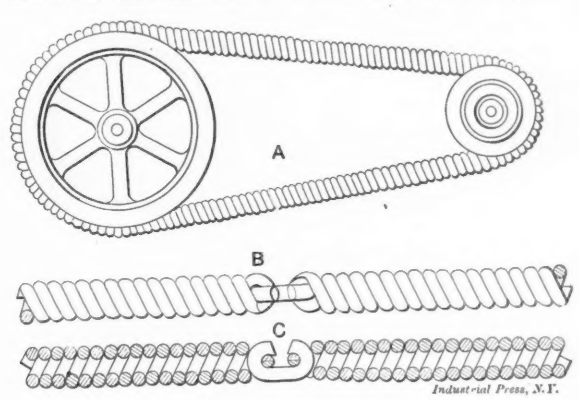


Adjustable Jaw Wrench.

firmly gripped in one direction and promptly released when the handle is moved in the opposite way. This is all right within limits, but likely to be somewhat exasperating when one works in a constrained place where only one hand can be used to operate the wrench. Again, the angle at which the jaws stand relative to the handle, varies with the size of the nut. It is unnecessary to point out the nature of this defect to those who appreciate the advantage of the 15-degree angle jaws as found in drop-forged wrenches. There seems to be little likelihood that anything better can be devised for the machinist's use than a set of good case-hardened solid jaw drop-forged wrenches and his old friend and companion, the monkey wrench.

COIL SPRING DRIVING BELT.

The use of steel wire coils for driving belts is something of a novelty—in this country at least. The illustration, Fig. 1, shows a German driving belt for light power that is made of wire closely coiled like a helical spring. In fact it is a spring, being made of tempered steel wire, and its elasticity is what makes it available as a power transmitter in place of leather or rubber belts. It is recommended by the maker, Gustave Pickhardt, Bonn a. Rh. for lathes, steam engine governors, sewing machines, tachometers, revolution counters, etc.



Spring Driving Belt.

Its use for lathes and other machine tools would, of course, be limited to those requiring little power such as bench, precision, watchmakers' and other foot-power lathes, sensitive drills, etc.

SLOTTING MACHINE OF GERMAN DESIGN.

A slotting machine containing some interesting features and illustrated in Figs. 1, 2 and 3, is made by the Berliner Werkzeugmaschinenfabrik A.-G. formerly L. Sentker. The ram is screw driven and is not counterbalanced. The driving screw *N*, Fig. 3, has ball thrust bearings and is driven by bevel gears and a short intermediate shaft *M* from a transverse shaft on which are mounted the tight pulleys *A A'* and loose pulleys *B B'*, Fig. 2. The ram, of course, normally works in a vertical position, but it may also be operated in an angular position, as provision is made to shift it around an

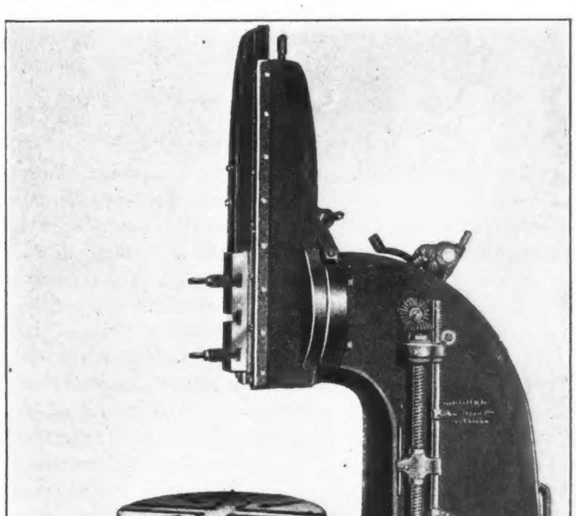
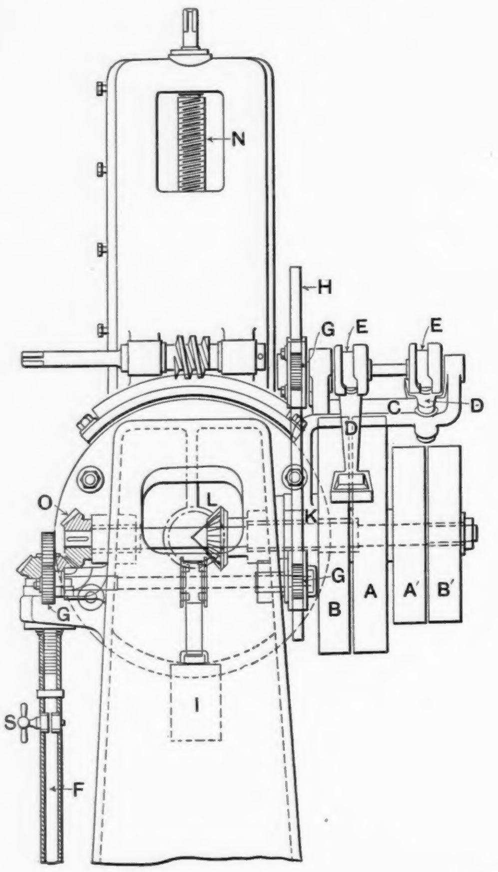


Fig. 1. A German Slotter.

axis coinciding with that of the horizontal shaft *M*, about 30 degrees each side of the vertical line. A worm and section of wormwheel are provided for shifting it, and four clamping bolts for holding it in any position. The chief feature of interest aside from the driving mechanism is the method of ram reversal. The transverse driving shaft is continued through the column and is geared to the upper end of a vertical screw *Q*, Fig. 3, on which is mounted a nut *R*. This nut has the same length of traverse as the slide and moves in the same direction coincident with it. The points of reversal

are determined by the positions of the dogs or stops *S* which are clamped to the vertical shifter *F*. A handle is also fastened to the shifter for the convenience of the operator. Some other interesting details may be noted from the illustrations, which were taken from the *Zeitschrift des Vereines deutscher Ingenieure.*



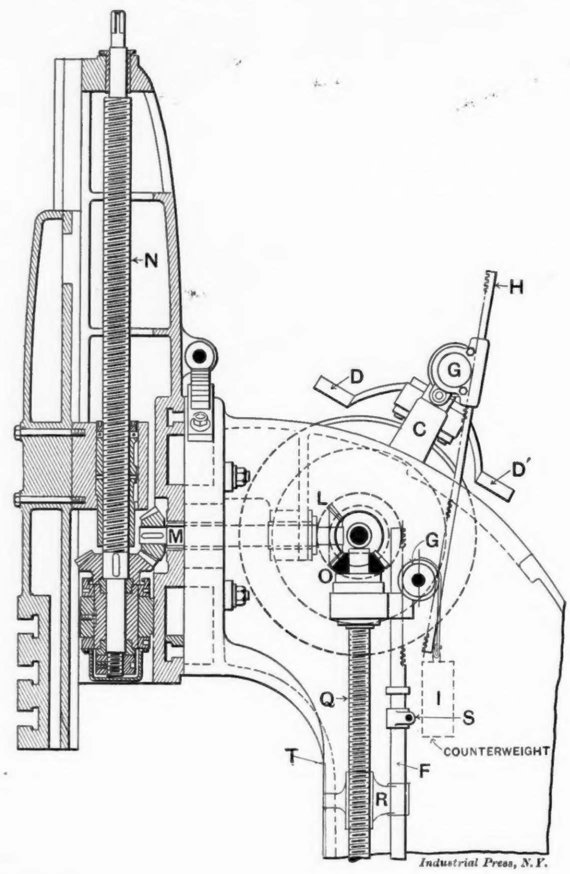


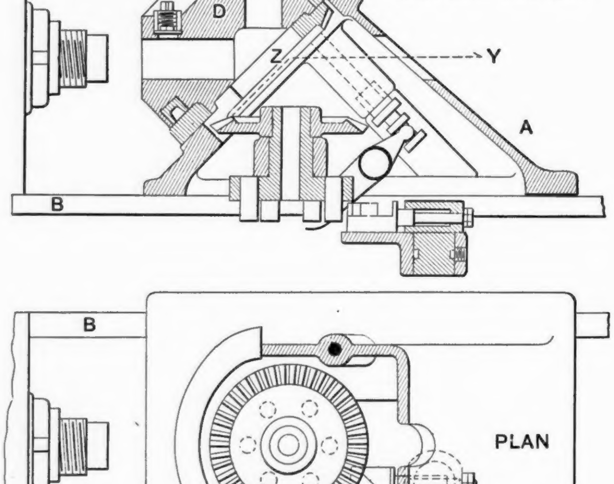
Fig. 2. Detail of Head of German Slotter. Fig. 3.

SLOW-BURNING CONSTRUCTION.

The "slow-burning construction," so frequently employed in the best factory buildings, has a wonderful capacity for resisting the ravages of fire. The heavy timbers which constitute the columns and floor beams, and the thick plank flooring, often stand up under the intense heat of a fire better than the so-called fireproof construction of structural steel, covered with non-conducting material. The heavy wooden timbers char, but do not burn through for a long time, while the steel members of the fireproof buildings warp and twist out of shape. Mr. J. A. Brown, superintendent of building inspection, Pittsburg, gives an example of a fire in a nine-story building of the slow-burning class. He says the building was packed with furniture from bottom to top and the goods in the three upper stories were practically burned up. On the seventh floor was stored a very large quantity of chair materials, packed from floor to ceiling. This material was all consumed, leaving on the floor ashes or charcoal from sixteen to eighteen inches in depth. The wooden beams or girders of the floor above the same, being 10 x 14 in size, were only partially destroyed; some of them burned half way through, none of them entirely. The fire in this story burned fiercely for about four hours.

TURRET CONSTRUCTION HAVING UNLIMITED CAPACITY FOR LONG WORK.

The ordinary turret cannot handle work quite as long as its diameter when all the holes are occupied by tools. A number of designs of turrets have been made to give unlimited capacity to the length of piece being worked regardless of whether all the tool holders in the turret are occupied or not. One form of construction used in the shop of an Eastern manufacturer of brass goods offsets the turret so that the center line of the lathe spindle passes by the side of the turret. The tools are fastened on its side and operate on the work as it passes by. Another design of recent date employs a ring turret that surrounds the lathe bed and rotates on a horizontal axis. The accompanying cuts show a recent German lathe design (Pittler) in which the turret is mounted so that its axis is inclined at an angle of 45 degrees to the spindle axis. The holes in the turret are inclined at the same angle to the base and so they are separated by an angle of 90 degrees, that is, opposite holes. The bevel gear ring by which the turret is turned, allows the work to pass through without interference; therefore, an indefinitely long piece may be turned or threaded. This construction is very



Turret for Long Work.

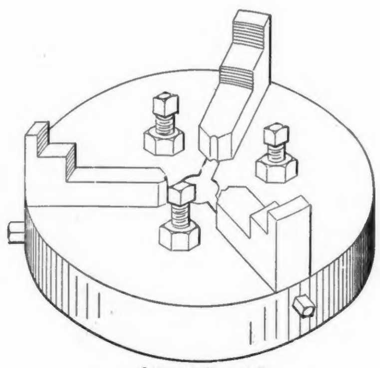
similar to that of a tailstock turret made by the W. F. & John Barnes Co. for several years past. In this turret, however, the angle of inclination is 30 degrees and no provision is made for long work to pass through.

CONTRIBUTED NOTES AND SHOP KINKS.

TRUING WORK IN A CHUCK.

John Aspenleiter, Cincinnati, Ohio, sends us a kink for truing up work in a chuck when a number of disks, flanges or pieces of that nature are to be bored.

As all machinists know, a great deal of time is often wasted in getting the face of the work to run true in the chuck. To remedy this difficulty, three holes are tapped in the face of the chuck, between the jaws, and a setscrew with check nut



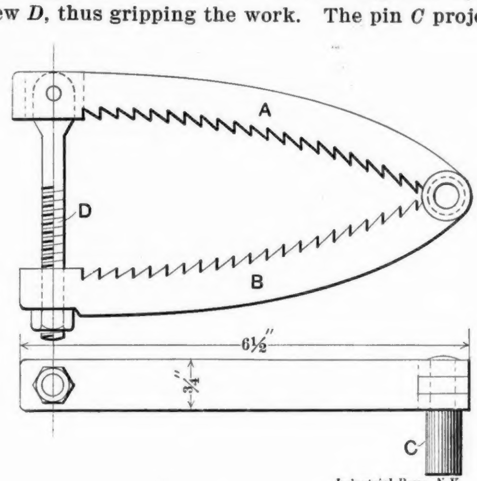
provided for each hole. If the screws are set correctly for the first piece and then locked with the check nuts, all that is necessary for the following pieces is to butt them up against the screw heads and they will run all right.

A "NEVER-SLIP" LATHE DOG.

Warren O. Rogers, Brockton, Mass., writes:

Some years ago, when I was employed as a machinist, among the petty annoyances that would occur was that caused by the slipping of the dog on round work, supported in the lathe centers. I had, however, never seen anything to obviate this difficulty until a few days ago, when I saw a dog that overcame the trouble in a very satisfactory manner. I think this may be of interest to some of the readers of MACHINERY.

As is shown in the sketch, the dog consists of two straps A and B, which are jointed at one end by a dovetail and pin C, while the opposite ends may be drawn together by the nut and screw D, thus gripping the work. The pin C projects from



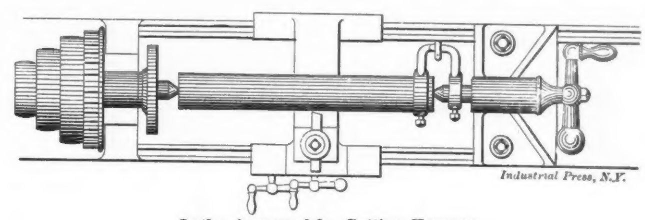
Lathe Dog.

one side and is used for driving the work. A dog of the dimensions given is suitable to use with work from ¼ inch to 2 inches in diameter.

With this dog, if the work has a tendency to slip, it simply forces itself toward the apex formed by the jaws and thus increases the grip of the dog on the work.

CUTTING KEYWAYS IN A LATHE.

John Aspenleiter, Cincinnati, Ohio, says that in a small shop where there is no shaper, or where the shaper is in use, and it is necessary to cut a small keyway in a shaft, the job can be done in a lathe in a quicker and more satisfactory manner than by chipping and filing. Put the shaft on the centers, as shown in the sketch. Place a lathe dog on the end of the shaft toward the tailstock and another on the tailstock spindle. Clamp the tails of the two dogs together, thus preventing the shaft from turning, yet leaving the live center free. Now put the tool in the tool post with the cutting edge facing the headstock. Gear up the lathe to give the proper cutting speed and use the leadscrew to drive the carriage



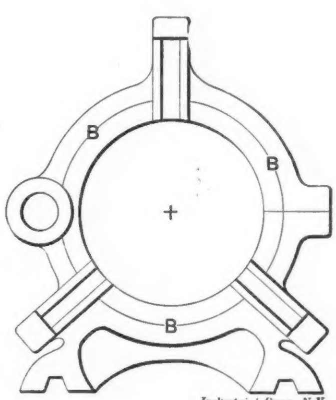
Lathe Arranged for Cutting Keyway.

the same as when chasing a thread. At the end of each cut pull out the tool by the cross feed screw and return the carriage for another cut.

If the keyway is very short, the carriage can be fed by hand, but for cutting a keyway of any length it is preferable to use the leadscrew.

CENTERING WORK IN STEADY REST.

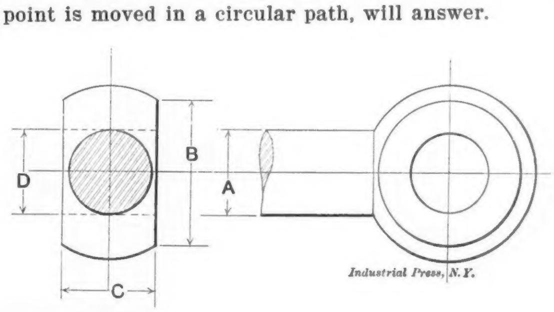
J. W. S. sends a "kink" for ascertaining if work is central when placed in the steady-rest. He first removes the jaws



and then with a tracing tool, held in chuck or fastened to the faceplate, he describes the circle B B on the body of the rest. The work is then easily centered by measuring to this circle.

PROPORTIONS OF LINK ENDS.

Robert S. Brown sends a sketch of a steel link end which has proved very satisfactory for use on automatic machinery, engine link motions, etc.; as it gives a finished appearance without costing too much to manufacture. The spherical end may be turned in any lathe which has a swivel tool carriage; or an attachment for turning hand wheel rims, in which the tool point is moved in a circular path, will answer.



The dimensions are:

A = diameter of link at body.

$B = 1\frac{1}{2}\ D + \frac{1}{8}$ inch.

$C = A$ + 1-16 inch.

$D = A$.

The flat spot B will be seen to give as much bearing as is found between flats on a standard hexagon nut of the nominal size of D.

NEW TOOLS OF THE MONTH.

A RECORD OF NEW TOOLS AND APPLIANCES FOR MACHINE SHOP USE.

DUPLEX TRAVELING HEAD SHAPER.

The traveling head shaper shown in the engraving has been brought out by the Morton Manufacturing Co., of Muskegon Heights, Mich., and embodies several new and useful features. The shaper is electrically driven and operates on the "draw cut" principle.

This machine has 36-inch stroke, 30-inch vertical feed on the column, and the length of the bed is 14 feet. It is built either single or double-headed and furnished with one or two tables as the case may require. When it is desired, the tables may be constructed to raise and lower for purposes of adjustment.

The machine has automatic feeds in both directions and is also provided with means whereby the aprons and columns may be moved by power, either vertically or horizontally when adjusting them to the work. The movement of the column on the bed is obtained by a screw which remains stationary, the nut revolving. The apron of the shaper is gibbed and fitted to the vertical column, and the vertical adjusting screw is also stationary, being operated with a revolving nut. These revolving nuts are fitted with ball-bearing thrust collars.

The ram is square and has a bearing on all four sides, wear being taken up with taper gibs. The stroke is adjusted by tappets on a circular disk and a suitable lever is provided whereby it may be reversed at any part of the stroke. The reciprocatory motion of the ram is obtained by two friction clutches, one being operated by an open belt and the other by a cross belt. It has a quick return stroke of three to one.

The countershaft is provided with a friction clutch and is stopped and started instantly at any part of the stroke by means of a lever provided for this purpose, which brings the machine under complete control of the operator.

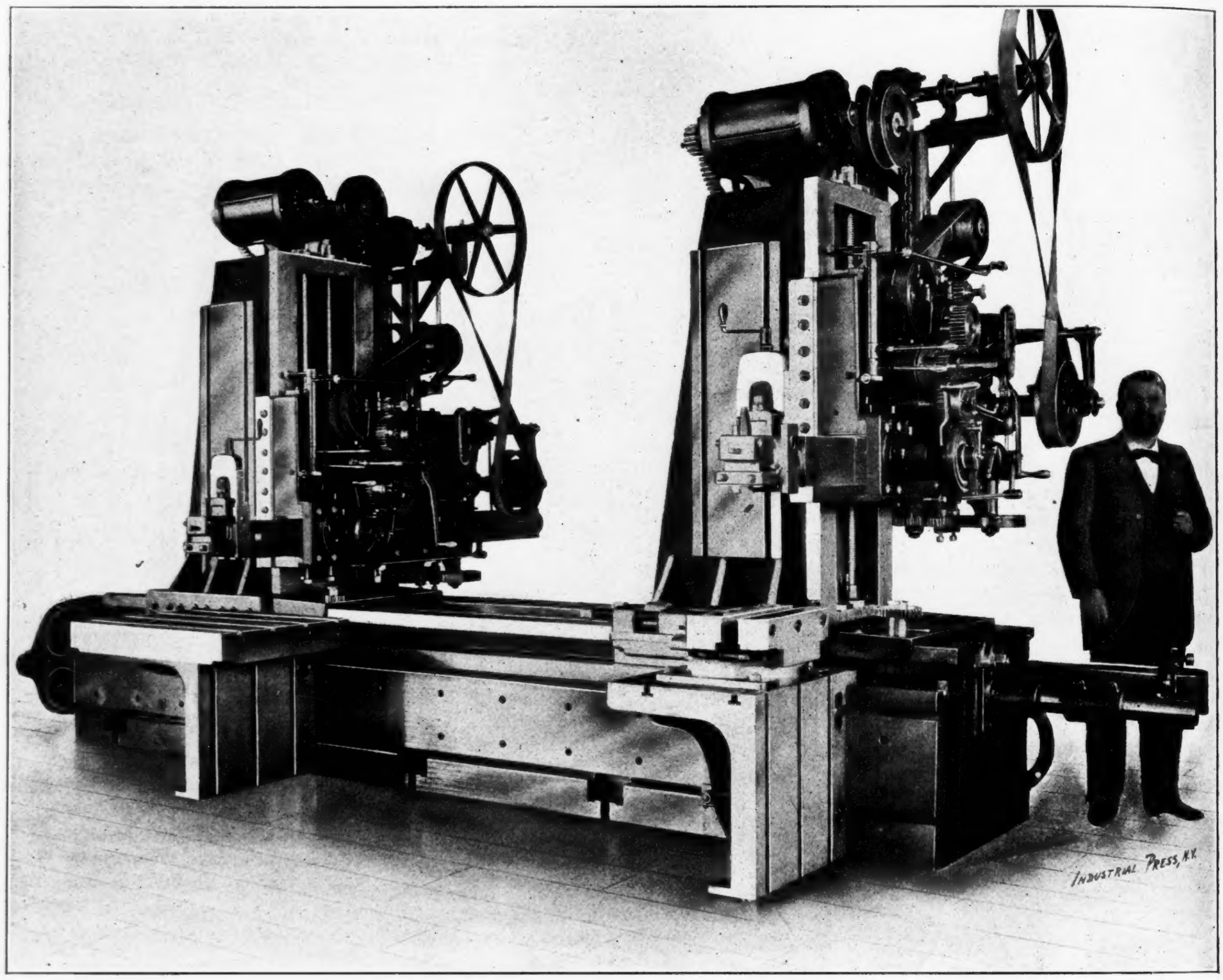
The friction feed is of the automatic relieving type and is positive in its movements.

The aprons are counterbalanced by a special coil spring arrangement inclosed in the cylindrical casing at the top of the column. The rail bearings on all portions of the machine are square and the gibs employed are of the taper type.

One commendable feature of this shaper in which it differs from any other that has ever been produced before, is that of the vertical feed on the column, which enables the machine to take vertical side cuts and makes it well adapted for internal work. The head may be removed and a special head, shown in Fig. 1, secured to the end of the ram so that internal slotting may be accomplished with this tool. Each head is driven independently, so that either one may be brought into action and operated entirely independent of the other. Both heads obtain their feeding power with revolving nuts from the same screw.

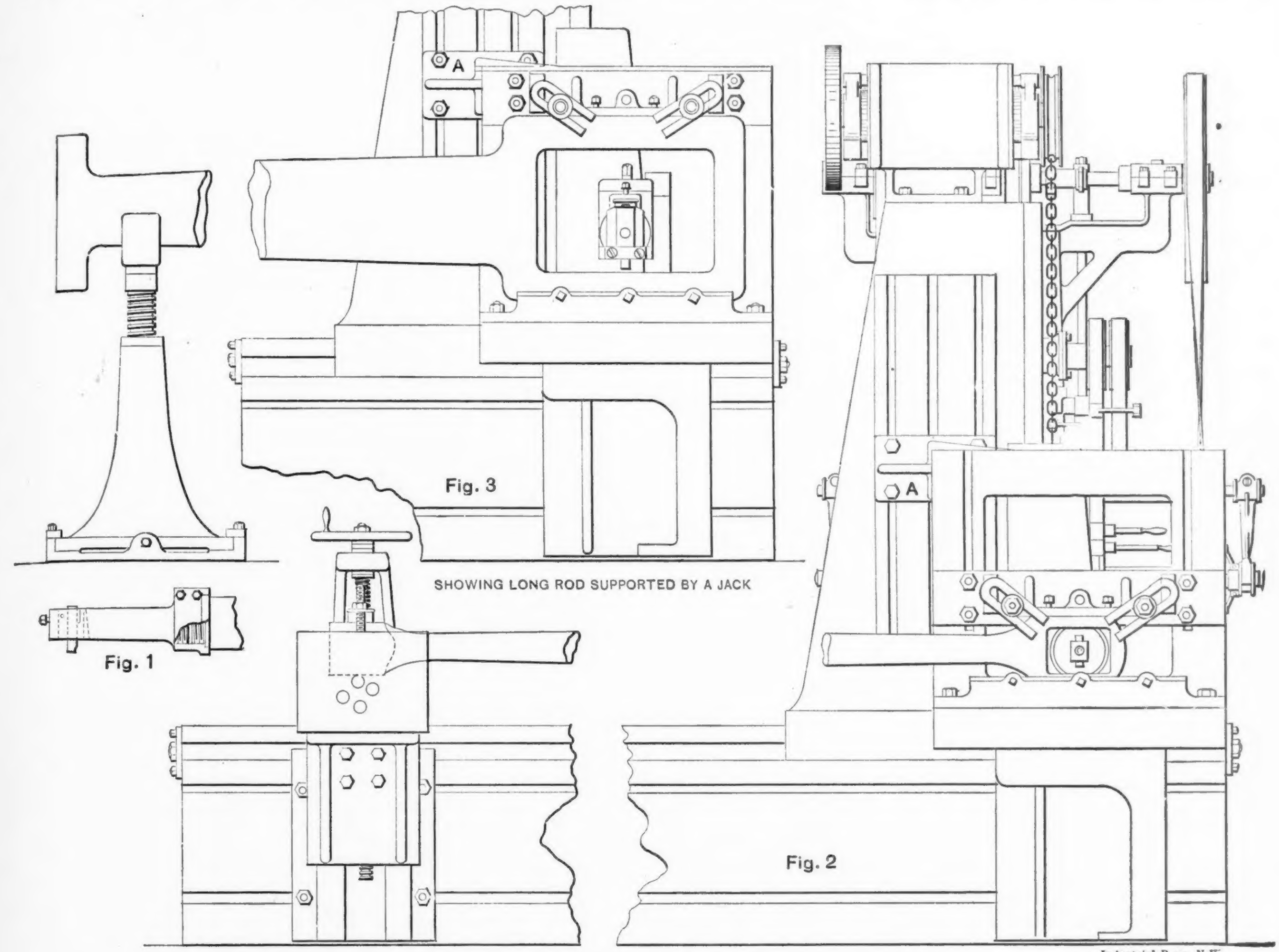
A particular advantage with this style of shaper is that one head can be operated on a piece of work 30 inches above the table, while the other head may be operated at any intermediate point.

The illustrations, Figs. 2 and 3 on the next page, show this shaper machining an opening in a solid end connecting rod. It will be noticed that a suitable adjustable chuck is provided for holding the end of the rod to be ma-



Duplex Traveling Head Shaper.

chined, and a support *A* is placed between the top of this chuck and the column of the shaper. This allows the machine to be fed vertically or horizontally. When machining the opening, a cut may be taken across the bottom, then the head turned ninety degrees and a cut taken up the side; it can then be changed and a cut taken across the top and another change made and a cut taken down the end. This



Traveling Head Shaper Operating on a Connecting Rod.

enables the opening of a connecting rod to be planed out on all four sides, the rod remaining in a stationary position.

As will be seen in Fig. 2, the outer end of the rod is supported in a suitable chuck placed on the second table of the machine. When but one table is furnished an adjustable jack, shown in Fig. 3, is used for this purpose.

It will be seen that with the automatic feeds on the column and the range which the shaper has, a great deal of irregular work may be accomplished which has heretofore been difficult to reach with any tool.

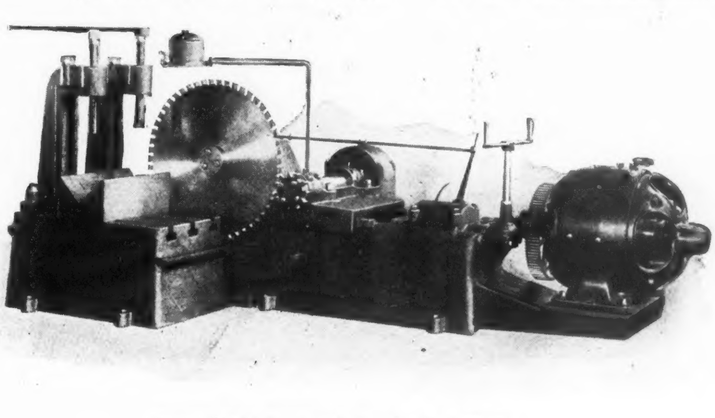
It may also be used in the capacity of a portable shaper, as with the vertical adjustments on the column, it is adapted to be used in connection with a floor plate, in planing off spots on large castings, pillow blocks for medium-sized Corliss engine frames, etc. The plate on the front side of the column is planed so that a suitable bearing may be placed in between the work and the frame of the machine, thereby putting the thrust of the cut directly against the column.

This shaper is very heavily geared and capable of taking a cut of $1\frac{1}{4}$ inch deep in steel, with 1-16 inch feed.

NEW LINE OF COLD SAWS.

The Q. & C. Co., Chicago, Ill., have recently brought out a line of metal cutting machines embodying several improvements over those formerly built by them. They manufacture two types of these machines—"Bryant" saws, in which the saw blade is driven by a gear or sprocket wheel engaging with the teeth formed on the periphery of the blade, and arbor-driven saws, on which the saw blade is driven by a central mandrel or arbor. Both types are made either as cut-off saws, having a short travel and especially suited for cutting bars and structural shapes; or as universal saws in which the travel of the blade is longer and the machine is fitted with an upper side table on which the work can be cut off for the entire length of the travel of the saw blade, while they are also arranged with V-blocks and lower tables for cutting bars and shapes.

The illustration shows one of the Bryant type of saws operated by an electric motor. They are also manufactured



Bryant Cold Saw made by the Q. & C. Co.

for belt driving. Any machine can, when desired, be mounted on a circular base, which can be completely rotated by rack and pinion, this being a very desirable feature where there is not sufficient room for swinging a long beam. Lateral adjustment of side tables can be furnished, if required, so that work can be adjusted for cutting after being secured.

The tables, on all machines, have been so arranged that work can be placed most advantageously for cutting with minimum distance of blade travel, the longer slide tables being of sufficient length to properly support beams when being cut off at any angle up to 45 degrees.

All machines are fitted with friction feed, giving an automatic feed, variable with the machine in motion, from ¼ inch to 1 inch per minute on the Bryant saw and from 3-16 to 13-16 inch per minute on the arbor-driven saws.

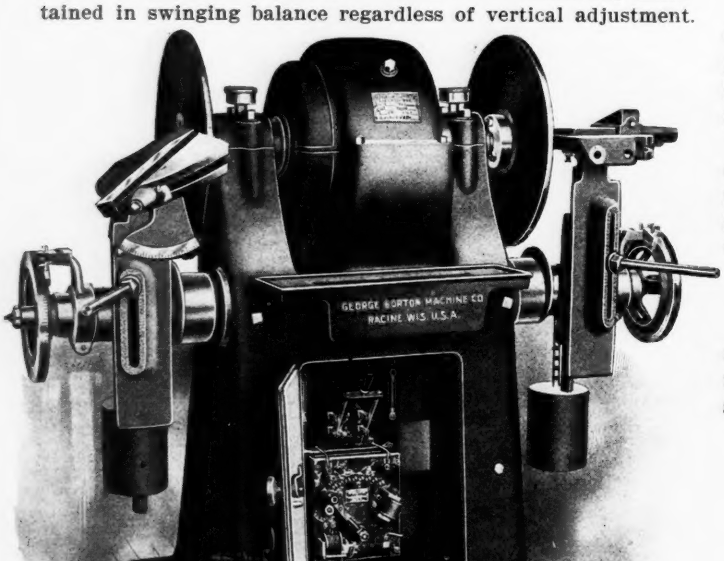
The universal type of machines is fitted with a power return movement.

The "Bryant" saw carriage is in two parts, the sprocket shaft bearing being cast in one piece with the worm gear hood, and movable 2½ inches toward the axis of the blade, allowing for a wear of 5 inches in its diameter. The sprocket is removable, and all sprockets on these saws are interchangeable and readily replaced.

All gears, in both types, are entirely inclosed, thereby avoiding dust and lessening liability to accident.

ELECTRICALLY-DRIVEN DISK GRINDER.

The George Gorton Machine Co., Racine, Wis., have designed their No. 6 B disk grinder for electric driving. The machine has a pedestal cast in one piece, heavily ribbed, internally, and is provided with a dust-proof, automatically ventilated, 5 horse power compound-wound motor. The arbor is of hard tool steel and the armature is mounted upon a conical bearing upon the arbor so that it may readily be removed without driving. The machine is dust-proof throughout and particular attention has been given to the matter of lubrication. The tool is provided with the company's standard feed works upon each table. The handwheels register in thousandths of an inch and are provided with adjustable stop. The left-hand table is adjustable in degrees to the face of the disk and both tables are provided with protractors reading in degrees, which are quickly detached when desired. Each table may be adjusted vertically and is balanced, and is automatically maintained in swinging balance regardless of vertical adjustment.



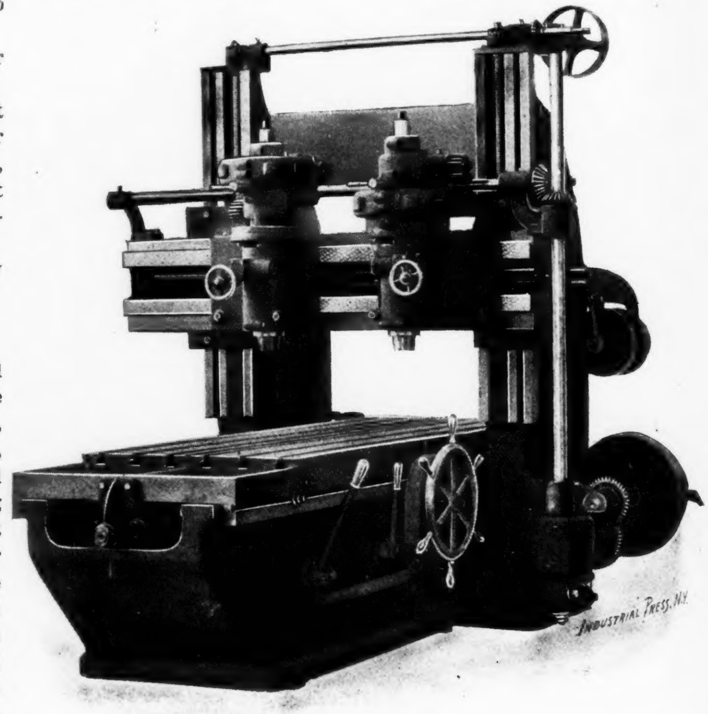
Electrically-driven Disk Grinder.

Each machine has four 18-inch steel disks, accurately finished, a cementing press for the same being provided, with positive means for raising the steel disk from the lower press flange. A water pan is furnished, with a shelf at the rear having a pocket for wrenches, which are also provided. The net weight of the machine is 2,100 pounds.

NEW DOUBLE SPINDLE MILLING MACHINE.

The Beaman & Smith Co., Providence, R. I., have brought out a milling machine having two vertical spindles, illustrated herewith. It consists of a substantial bed on which is mounted a table, and to which uprights supporting the cross rail for the milling heads are firmly attached. The features of the machine are clearly shown in the illustration and it will not be necessary to do more than give the general specifications.

The table is 36 inches wide, 8 feet long, and in addition to the



Beaman & Smith Double Spindle Milling Machine.

usual feeds by means of a screw, it is provided with quick power movement in either direction. On the cross rail are the heads carrying spindles, which are provided with horizontal adjustment by means of screws.

The spindles are driven by a 3-inch belt on a four-section cone through gearing in the ratios of 4½, 10, 19 and 40 to 1, providing spindle speeds from 6 to 91 revolutions per minute in either direction. They are also provided with independent vertical adjustment of 3 inches.

A NEW SURFACE GAGE.

The Sawyer Tool Mfg. Co., of Fitchburg, Mass., have brought out a new surface gage provided with micrometer adjustment. The sides of the base are ground parallel and true and upon the upper surface are two bosses for use in planer

Improved Surface Gage.

bed slots or similar positions. The base is slotted so that the spindle can be revolved through three-quarters of a circle, thus giving a wide range of adjustment. The clamp upon the spindle holds a block which can be swung either up or down to any desired angle and clamped solidly in position. A knurled thumb screw, on the under side of this block, holds the needle or scriber in position; while a knurled head, on the

upper side, gives the needle an up-and-down parallel motion. This motion will be appreciated as a very desirable feature of the gage. The knurled head in front clamps the needle rigidly when the adjustment has been made.

THE BATH AUTOMATIC, UNIVERSAL COMBINATION GRINDER.

Figs. 1 and 2 show a new design of an automatic universal combination grinder, which is being manufactured by the Loop-Lock Machine Co., of Waltham, Mass., successors to the American Watch Tool Co., under the direction of the inventor, Mr. John Bath. The machine is being placed on the market by Messrs. Hill, Clarke & Co , of Boston, New York, and Chicago.

Fig. 1 shows the machine arranged for cylindrical grinding. The wheel is guarded by an adjustable band and provision is made for the use of water.

The knee and frame of the machine are so constructed that all water returns by the trough, shown around the base of machine, to the tank. This attachment is so constructed that it takes away all the water, producing no slop around the machine.

The wheel head is carried by a vertical arm, the top portion of which is threaded, and is moved up and down by a combined hand wheel, nut and dust cap. This is provided with a micrometer adjustment. The head is also gibbed to a vertical slide which provides rigidity in any position.

The swivel plate has two slots which permit of the headstock, footstock or attachments being removed without any interference with the head of the clamping screw which preserves the set alignment of the swivel plate. The two slots are also useful in clamping work for surface grinding.

Fig. 2 shows the knee swung around the column in position for surface work, and also the new automatic longitudinal feed. The feed is driven from a drum above, in the countershaft, to a cone pulley at the side of the knee. When in

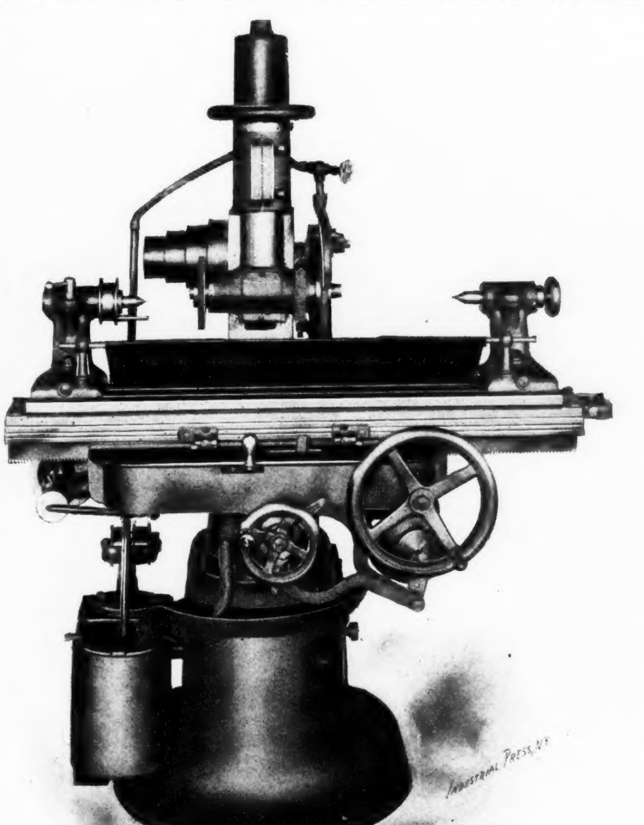


Fig. 1. Bath Grinder arranged for Circular Grinding.

use for cylindrical work the belt runs on large step of cone, and for surface work on small step, which gives the higher speed required for surface work.

The power cross-feed attachment for surface work is also shown. It is so constructed that either one or two pawls may be engaged at the same time, and adjusted to give a fine or coarse feed. The feed may be quickly disengaged by the knurled knob back of the large hand wheel.

At the front of the bottom slide is an enclosed box apron having a removable top cover, so that all the inside workings of the feed are accessible for inspection or adjustment.

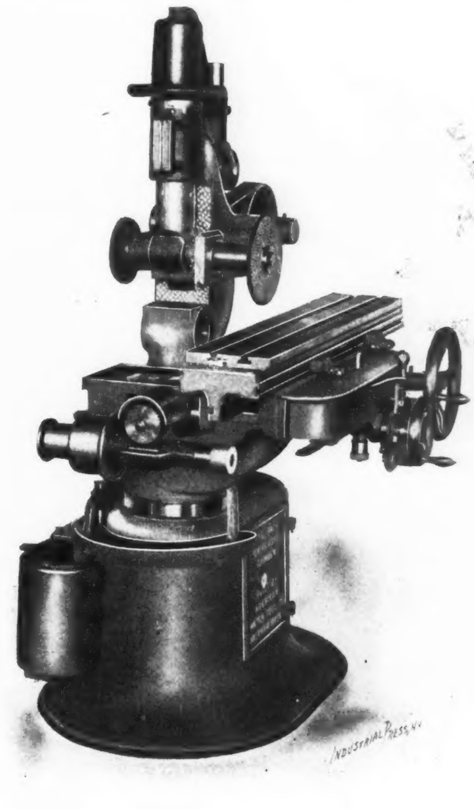


Fig. 2. Bath Grinder arranged for Surface Grinding.

In addition to its use for cylindrical and surface grinding, the machine is provided with numerous attachments that fit it for internal grinding and for grinding all kinds of milling cutters, reamers, twist drills, and lathe tools.

NEW HYDRAULIC PRESSES.

Figs. 1 and 2 on page 116 show two new hydraulic presses designed by Mr. Chas. F. Burroughs, which are being built and sold by the Charles F. Burroughs Company, of Newark, N. J.

These presses were originally intended for jewelers' use, for die sinking and similar purposes, but they are not confined to this field as they may be adapted to almost any purpose where hydraulic machinery is required.

The press consists of but three principal parts, the cylinder, plunger and platen; and the entire press rests upon a substantial base which contains the water used for raising the ram.

The cylinder may be copper lined or not, as the duty may require. A particular feature of the presses is that the cylinder, rods and head are all in one piece.

The smaller press, shown in Fig. 1, is arranged to be operated by the hand pump shown on the side. This pump contains an external and internal piston. The external piston is used to give a large quantity of water at a low pressure, after which it is securely locked down by means of the small handle, shown under the main lever, and at the same time the smaller internal piston is released, thereby enabling the operator to obtain the required high pressure.

Fig. 2 shows a press constructed after the manner of the smaller one, but with the pump arranged to be operated by power. This pump consists of an internal and external piston the same as the hand pump, except that the larger piston is actuated by the springs shown under the pump. These springs are sufficiently powerful to raise the press ram and give low pressure per square inch, after which they remain extended with the large pump piston at its upper stroke. The small internal piston continues to work, giving the required high pressure.

The power pump may be attached to the smaller press if it is desired.

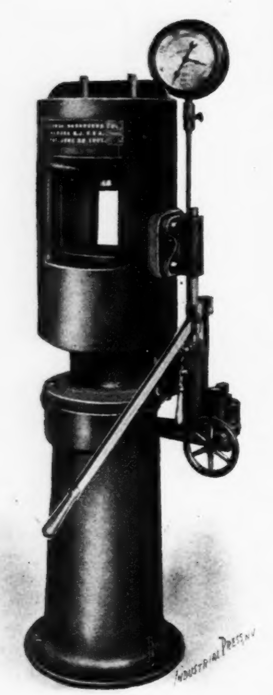


Fig. 1. Hand Hydraulic Press. Fig. 2. Power Hydraulic Press.

The small press has a capacity of 300 tons and weighs but 1,275 pounds; the larger press has a capacity of 500 tons and weighs 2,300 pounds. The floor space required for the small press is 1½ by 1½ feet and for the larger 2¼ by 2¼ feet.

DISK GRINDING ATTACHMENT FOR TWIST DRILL GRINDER.

L. S. Heald & Son, of Barre, Mass., have brought out an attachment for their twist drill grinder in the shape of a disk grinding attachment which is substituted for the thinning attachment frequently sent out on these machines. This disk grinding attachment consists of a large plate about 12 inches diameter, together with a suitable table which can be tipped to make any angle with the face of the wheel and oscillates on the end of the sleeve, back and forth on the wheel face; or it may be clamped rigidly in any particular position.

Disk Grinding Attachment.

This attachment is designed for grinding and polishing in those shops where the amount of work is not of sufficient quantity to warrant the installation of a regular disk grinding machine.

This fixture is capable of being attached to any of their twist drill grinders now in use.

COLD SAW CUTTING-OFF MACHINES.

A new line of cold saw cutting-off machines is being built by the Espen-Lucas Machine Works, of Philadelphia, after the design of Mr. W. H. Lucas. These machines are being built for cutting bar steel and I beams, and there are three sizes of each pattern. The clamp is swiveled so that it can be quickly adjusted to odd shapes or for cutting on angles. Saw blades 3-16 inch in thickness and 22 inches in diameter are used. The feed is automatic, with automatic safety stops controlling the depth of cut, and is variable from ¼ inch to 1½ inch per minute. The lubrication of the saw is provided for by an oil box in which it constantly revolves.

* * *

ADVERTISING LITERATURE.

THE FRANKLIN MACHINE WORKS, Philadelphia, Pa. Illustrated catalogue of horizontal floor boring, milling and drilling machines. Also of cold-saw cutting-off machinery and of plain milling machines.

SCHUMACHER & BOYE, Cincinnati, O. Special circular descriptive of their 36 and 42-inch triple-geared and back-geared engine lathes. The circular contains a number of fine illustrations of these lathes and a full description of same.

THE STANDARD TOOL CO., Athol, Mass. 1902 catalogue of mechanics' fine tools. These include surface gages, steel squares, try-squares, depth gages, bevel protractors, straightedges, calipers, dividers, etc.

THE BRADFORD MACHINE TOOL CO., Cincinnati, O. Circular of their 16-inch engine lathe, containing a full description of this lathe and a cut of same. The lathe is also made in 14, 18, 21, 25, 28 and 32-inch sizes.

THE NORTHERN ELECTRICAL MFG. CO., Madison, Wis. Bulletin No. 29 of the "Northern" multipolar motors. The motors and their various parts are fully described and illustrated, and the booklet shows in a very complete manner the variety of "Northern" apparatus.

THE NEW HAVEN MFG. CO., New Haven, Conn. Catalogue A of iron-working machine tools, including iron planers, from 20 to 60 inches wide; engine lathes, from 18 to 65 inches' swing, and drilling machines, 28 to 40 inches' swing. The catalogue is handsomely illustrated.

WYMAN & GORDON, Worcester, Mass. Pamphlet giving a short account of the life of Sir Henry Bessemer, of Bessemer steel fame, and calling attention to the steel forgings manufactured by the company. These are made by drop hammer, steam hammer and hydraulic press.

THE LUNKENHEIMER CO. Cincinnati, O. Illustrated catalogue and price list of brass and iron valves, injectors, whistles, lubricators and steam specialties. This catalogue contains 208 pages, is fully illustrated and will prove valuable to prospective purchasers of such specialties. The catalogue can be procured gratis by addressing the company.

THE GARVIN MACHINE CO., New York. Catalogues Nos. 10, 12 and 14 of the series issued by this company. No. 10 treats of their screw machine tools and attachments; No. 12, of duplex drill lathes, hand lathes, slide rests and spring coilers; and No. 14, of their special machinery. No. 14 also contains a general index of the company's products.

THE HAYDEN & DERBY MFG. CO., 85-89 Liberty St., New York. Illustrated catalogue of the "Metropolitan" automatic injectors, Metropolitan 1898 injectors, and Metropolitan double tube injectors manufactured by this company. Also of the H. D. ejectors and of other jet apparatus. The catalogue contains, besides, much useful information relative to injectors and ejectors, and will be sent to any-one interested.

THE WORCESTER EMERY WHEEL CO. Worcester, Mass. Circular of the emery and corundum wheels, for fine and rough work, manufactured by this company. Silicate or semi-vitrified wheels, and thin elastic wheels for light grinding or for the grinding of thin, hard stock are also made; and the company also take orders for wheels for special work. A table of grades of emery for various kinds of work and one of the different speeds of emery wheels are given in the circular.

MANUFACTURERS' NOTES.

THE AUTOMATIC MACHINE CO., Greenfield, Mass., manufacturers of machine tools, are building a new shop 120 feet square, with a wing 35 x 40 feet. They expect to move in about October 1.

THE BAUSH MACHINE TOOL CO., Springfield, Mass., manufacturers of multiple spindle and radial drills, etc., are adding to their foundry a storeroom and a room for tumbling barrels 30 x 75, 17 feet high.

THE JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J., have gotten out an ingenious color chart for so displaying the colors of Dixon's silica-graphite paint as to give an exact idea of each color. The chart also contains instructions for applying the protective paint.

THE WHITON MACHINE CO., New London, Conn., manufacturers of the Whiton revolving centering machine, are building a foundry 66 x 127 feet, and an adition to their machine shop 35 x 80 and 50 x 54 feet, three stories high.

IN the advertisement of the Wm. E. Gang Co.'s improved radial drill in our September number, page 33, an error appears in the first paragraph. Instead of reading "The arm is of *one* section, well ribbed," it should have been "The arm is of *box* section, well ribbed."

THE CLING-SURFACE MFG. CO., Buffalo, N. Y., send us a copy of a letter received by them from the Dominion Motor and Machine Co., of Toronto, expressing their satisfaction with Cling-Surface, and stating that by its use they save from 5 to 10 per cent on their horse power.

THE LOOP-LOCK MACHINE CO., of Boston, have acquired the plant, business and good-will of the American Watch Tool Co., Waltham, Mass. The manufacture of precision machinery, compound punches and dies, watchmakers' lathes and attachments will be continued by the Loop-Lock company, to whom all checks are now payable. The president of the new corporation is H. N. Fisher; the treasurer, S. A. Barton.

THE HAMPDEN CORUNDUM WHEEL CO., Springfield, Mass., whose works were destroyed by fire some months ago, now have their new plant in full operation. The buildings are all of brick, of modern construction, and both the office and works are thoroughly equipped throughout. The main building is 80 x 136, four stories and connected with it by bridges are the office and storeroom 50 x 120. The kilns are of the latest design, of two and one-half times the former capacity, and they effect a great saving in fuel over the old ones.

THE BRADLEY CO., Syracuse, N. Y., manufacturers of upright hammers, have commenced work on a new machine shop 80 x 260, one